THE PLANT DISEASE REPORTER

Issued By

PLANT DISEASE EPIDEMICS
and
IDENTIFICATION SECTION

AGRICULTURAL RESEARCH SERVICE

UNITED STATES DEPARTMENT OF AGRICULTURE

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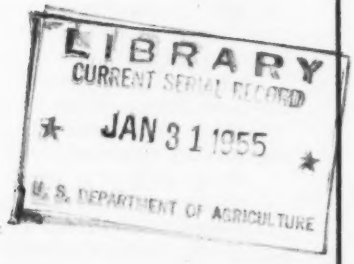

The Plant Disease Reporter is issued as a service to plant pathologists throughout the United States. It contains reports, summaries, observations, and comments submitted voluntarily by qualified observers. These reports often are in the form of suggestions, queries, and opinions, frequently purely tentative, offered for consideration or discussion rather than as matters of established fact. In accepting and publishing this material the Plant Disease Epidemics and Identification Section serves merely as an informational clearing house. It does not assume responsibility for the subject matter.

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PLANT DISEASE EPIDEMICS AND IDENTIFICATION SECTION

Horticultural Crops Research Branch Plant Industry Station, Beltsville, Maryland
Volume 39 January 15, 1955 Number 1

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NOTES ON PLANT PARASITIC NEMATODES IN LOUISIANA

W. J. Martin and W. Birchfield

Since 1950 records have been made and specimens collected and preserved of the various known or suspected plant parasitic nematodes found in association with crop plants in Louisiana. Brief abstracts of this work have been published (1, 2, 3, 4, 5, 6, 7). The purpose of this paper is to record the occurrence of these nematodes and to give results of host plant studies which have been made under controlled conditions in steam-sterilized soil with certain of the species. The following is the list of nematodes:

1. Aphelenchoides besseyi Christie, 1942; in rice and strawberry plants, causing White Tip and Dwarf, respectively. Occurrence is general in the rice and strawberry belts.
2. Belonolaimus gracilis Steiner, 1942; in the vicinity of sugarcane roots in one locality at Grand Isle. Hand-picked specimens propagated on sugarcane roots in steam-sterilized soil in pot experiments. Root injury was not prominent.
3. Criconemoides annulatum Taylor, 1936; from soil in the vicinity of roots of snap bean and citrus in Plaquemines Parish.
4. Criconemoides sp. from soil in the vicinity of roots of sugarcane, cotton, sweetpotatoes.
5. Ditylenchus sp., on phlox, from greenhouse plants.
6. Ditylenchus sp. from soil surrounding roots of cotton plants at Baton Rouge.
7. Dorylaimus sp. from soil in the vicinity of roots of soybean, cotton, sugarcane, sweetpotato, strawberry, and many other plants.
8. Helicotylenchus nannus Steiner, 1945; from soil in the vicinity of roots of boxwood (Buxus sp.).
9. Helicotylenchus sp. from soil in the vicinity of roots of cotton, corn, sweetpotato, strawberry, sugarcane, and soybean. It occurred in greatest numbers in silt loam and sandy loam soils. Handpicked specimens in steam-sterilized soil propagated abundantly on the following hosts (varieties given in parentheses): lima bean (Carolina Seiva), cotton (Deltapine 15 and Coker 100 WR), corn (Golden Cross Bantam), sweetpotato (Unit 1 Porto Rico), strawberry (Klonmore and Konvoy), soybean (Pelican), and tomato (Rutgers). Root damage on these crops was not prominent. Only females of this nematode were observed.
10. Hoplolaimus coronatus Cobb, 1923; from soil in the vicinity of roots of sugarcane, cotton, soybean. Hand-picked specimens in steam-sterilized soil failed to maintain themselves on the roots of corn (Golden Cross Bantam).
11. Meloidogyne incognita (Kofoid & White, 1919) Chitwood, 1949; from roots of cotton, sweetpotato, lima bean, okra, tomato, Crowder pea, Amaranthus sp., and gardenia. Most of these specimens were obtained from the parishes in northern Louisiana. Parasitic races were demonstrated among isolates of these (3, 4).
12. Meloidogyne incognita var. acrita Chitwood, 1949; from roots of cotton, snap bean, tomato, okra, cucumber, beet, mustard, fig, vegetable pear, white clover, hairy vetch, Lamium amplexicaule, Amaranthus sp., and Convolvulus sp. Parasitic races were demonstrated among isolates of these (3, 4).
13. Meloidogyne hapla Chitwood, 1949; from roots of strawberry and potato. Inoculation experiments with this nematode on strawberry have shown it to be a very destructive root parasite under Louisiana conditions. Its distribution seems to be comparatively limited.
14. Nothotylenchus affinis Thorne; from soil in vicinity of sweetpotato roots.
15. Paratylenchus sp. from soil in the vicinity of roots of snap bean, tomato, okra.
16. Pratylenchus brachyurus Godfrey, 1932; from roots of cotton, tomato, strawberry, lima bean, okra, cowpea, lespedeza, crabgrass, Cassia chamaecrista. Only females observed.
17. Pratylenchus zeae Graham, 1951; from the roots of corn and from soils in strawberry fields. Hand-picked specimens in steam-sterilized soil propagated abundantly on corn (Golden Cross Bantam), but they failed to maintain themselves on the roots of strawberry (Klonmore). Only females observed.
18. Pratylenchus sp. from roots of sugarcane. Occurs generally on sugarcane in the State. Few males observed.
19. Pratylenchus sp. from soil in the vicinity of roots of sweetpotato, okra, and cotton, and from roots of cotton. Males relatively common.
20. Psilenchus sp. from soil in the vicinity of cotton roots.
21. Pungentus sp. from soil in the vicinity of cotton roots.

22. Rotylenchulus reniformis Linford & Oliveira, 1940; from the roots of cotton plants in one locality in East Baton Rouge Parish, Louisiana.

23. Rotylenchus multicinctus Cobb, 1893; from soil in the vicinity of tomato roots.

24. Rotylenchus sp. from soil in the vicinity of cotton and lespedeza roots.

25. Trichodorus sp. from the soil in the vicinity of cotton roots. Handpicked specimens in steam-sterilized soil propagated readily and abundantly on cotton (Deltapine 15 and Coker 100 WR), corn (Golden Cross Bantam), sweetpotato (Unit 1 Porto Rico), soybean (Pelican). Root damage on these crops was not prominent.

26. Trichodorus sp. from soil in the vicinity of strawberry roots.

27. Trichodorus sp. from soil in the vicinity of sugarcane roots in sandy soils.

28. Tylenchorhynchus claytoni Steiner, 1937; from soil in the vicinity of roots of strawberry, azalea, corn, and cotton. Hand-picked specimens in steam-sterilized soil propagated abundantly on the roots of corn (Golden Cross Bantam), strawberry (Klonmore, Konvoy, and Klondyke). Root damage on corn and strawberry was not prominent.

29. Tylenchorhynchus sp. from soil in the vicinity of roots of sugarcane, strawberry, camellia, sweetpotato, rice. This species was studied extensively by the junior author, who has demonstrated its pathogenicity on sugarcane (1, 2). Hand-picked specimens in steam-sterilized soil propagated on sugarcane (all of the 14 varieties tested), rice (Zenith), sweetpotato (Unit 1 Porto Rico), soybean (Pelican and Acadian), wild sweet clover, and Johnson grass. The nematodes failed to propagate on corn (White Tuxpan), cotton (Deltapine 15), and common Ligustrum. Occurs generally in sugarcane soils.

30. Tylenchorhynchus sp. from soil in the vicinity of sugarcane and sweetpotato roots.

31. Tylenchorhynchus sp. from soil in the vicinity of cotton roots. Hand-picked specimens in steam-sterilized soil propagated abundantly on cotton (Deltapine 15) and corn (Golden Cross Bantam). Injury to the roots of these crops appears to be minor.

32. Tylencholaimellus sp. from soil in the vicinity of sweetpotato roots.

33. Tylenchulus semi-penetrans Cobb, 1913; from roots of citrus in Plaquemines Parish, Louisiana.

34. Xiphinema americanum Cobb, 1913; from soil in the vicinity of cotton roots. Handpicked specimens in steam-sterilized soil failed to maintain themselves on the roots of corn (Golden Cross Bantam).

Specimens of the above nematodes were preserved in 5% formaldehyde solution after killing with gentle heat. They are deposited in a permanent collection in the Department of Plant Pathology at Louisiana State University. Most of the identifications of these nematodes were kindly made by A. L. Tyalor and other members of the Section of Nematology, Agricultural Research Service, Beltsville, Maryland.

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DEPARTMENT OF PLANT PATHOLOGY, LOUISIANA AGRICULTURAL EXPERIMENT STATION, BATON ROUGE

THE PRESENT KNOWN DISTRIBUTION OF THE STING NEMATODE, BELONOLAIMUS GRACILIS, IN THE COASTAL PLAIN OF THE SOUTHEASTERN UNITED STATES[1]

Q. L. Holdeman

The sting nematode, Belonolaimus gracilis Steiner 1949[2], produces one of the most devastating effects to be found in the sandy soils of the southeastern United States. Although this nematode has been causing crop failures in localized areas for more than 20 years, it was not until recent improvements in soil screening techniques were used to examine the soil that satisfactory methods were available for proper diagnosis of the problem.

Extensive surveys for sting nematode have not been made. Most of the known locations were called to the attention of agricultural workers as "trouble spots", where, upon investigation, the presence of the sting nematode was confirmed. However, although it is realized that a distribution map published at this time would not be complete, it is felt that the preliminary information should be made available (Fig. 1).

Confirmation of its presence in Virginia, North Carolina, South Carolina, Georgia, Florida, and Louisiana, and also in a rose greenhouse in Connecticut, indicates that the sting nematode is a regional problem. It is suggested that certain studies in the different States (i.e., host range and rotation studies) might be broadened to include the important field and forage crops of the Southeast.

A brief synopsis of the sting nematode problem in the various States has been prepared from information obtained through the courtesy of state and federal workers.

Virginia: The sting nematode has been confirmed in the following counties: Greenville, Isle of Wight, Nansemond, Southampton, Sussex and Surry. Principal crops affected by the nematode are: peanut, cotton, soybean, and corn.

North Carolina: The sting nematode has been confirmed in trouble spots in the following counties: Currituck, Chowan, Northampton, Pitt and Scotland. Other locations are suspected but have not been confirmed. Crops with which the nematode have been associated are: peanut, cotton, corn, Austrian winter pea, and soybean.

South Carolina: The sting nematode has been confirmed in trouble spots located in the following coastal plain counties: Barnwell, Clarendon, Darlington, Dillon, Florence, Horry, Marion, Marlboro, Richland, Sumter, and Williamsburg. Damage under field conditions has been observed on the following crops: cotton, corn, cowpea, peanut, soybean, and sweetpotato. Watermelon and tobacco are apparently immune. Fusarium wilt of cotton may or may not be associated with sting nematode infestations.

Georgia: Occurrence of the sting nematode has been confirmed in Berrien, Colquitt, Cook, Lowndes, Mitchell, and Tift Counties. Presumed hosts by confirmed association without qualification of effect are as follows: millet, sudan grass, oat, cotton, winter pea, several lupines, clover, corn, lespedeza, peanut, and a number of identified grasses and weeds.

Collections are inadequate to give a true picture of the problem.

Florida: The sting nematode has been confirmed in the following counties: Alachua, Bradford, Brevard, Charlotte, Duval, Gadsden, Hardee, Hernando, Highlands, Hillsborough, Lee, Manatee, Marion, Okaloosa, Orange, Pasco, Palm Beach, Pinellas, Polk, St. John, Sarasota, Seminole, Suwannee, and Volusia. In most instances, soil samples were brought into the laboratory by various workers. The exact locations were not always known. (Counties shaded on map.)

The general indication is that the nematode occurs over most of the State wherever susceptible crops are grown in sandy soils.

The latest development is its occurrence in turfs. The sting nematode will seriously injure Bermuda, centipede, and St. Augustine grasses. Other crops affected, sometimes severely, include bean, celery, corn, cowpea, lima bean, onion, pepper, strawberry, and pine tree seedlings (slash and long leaf). Potato, cabbage, cauliflower, squash, lettuce, endive,

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[1] The surveys were made in cooperation with the Section of Nematology, Horticultural Crops Research Branch, Agricultural Research Service, U. S. Department of Agriculture, and various State and Federal personnel working in the Southern Region. This compilation by Q. L. Holdeman has been made as a contribution to the program of work under Southern Regional Project S-19, Plant Parasitic Nematodes.

[2] It is probable that further study may reveal that more than one species of Belonolaimus is involved.

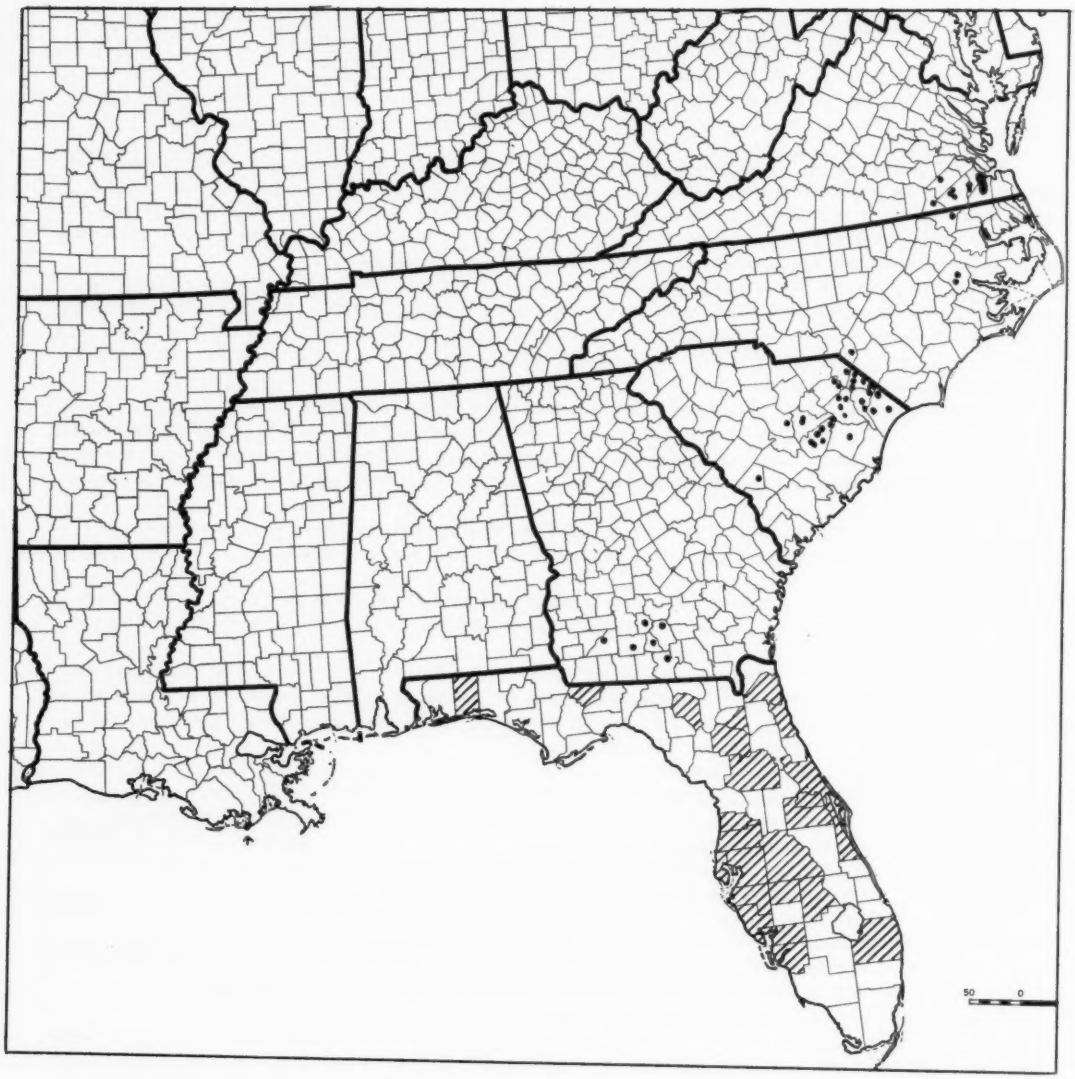

FIGURE 1. Map of Southeastern States showing confirmed field infestations of sting nematodes. Dots show general area of infested farm or farms. Shaded areas in Florida indicate counties from which infested soils were sent into the laboratory; exact location of many Florida farms not always known.

and gladiolus do not appear to be very susceptible although many different plants will be injured to some extent if they follow a highly susceptible crop on heavily infested land.

Although there has been no systematic survey for the sting nematode in relation to citrus the pest has been recorded from 35 citrus groves. The nematode reproduces very well when feeding on citrus. The roots of citrus are sometimes injured but available information does not indicate that instances of severe damage are common.

Alabama: The existence of the sting nematode has not been confirmed in Alabama; however, its occurrence is suspected in several known locations. Counties suspected of having farms infested are: Elmore, Henry, Houston, and Mobile.

Mississippi: The sting nematode has not been found in Mississippi; however, there are a few locations that merit checking.

Louisiana: The sting nematode has been recorded only from Grand Isle, Jefferson Parish. The nematode was associated with sugar cane roots. No extensive survey has been made specifically for the sting nematode; however, examination of many soil samples obtained from sugarcane, cotton, sweetpotato, and strawberry fields indicates that the nematode is not widespread in the State.

Arkansas, Tennessee, Kentucky: To date, the sting nematode has not been found in Arkansas, Tennessee, or Kentucky.

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PEE DEE EXPERIMENT STATION, CLEMSON AGRICULTURAL COLLEGE, FLORENCE, SOUTH CAROLINA, IN COOPERATION WITH HORTICULTURAL CROPS RESEARCH BRANCH, AGRICULTURAL RESEARCH SERVICE, AND OTHER STATE AND FEDERAL WORKERS

SOYBEAN CYST NEMATODE IN NORTH CAROLINA

N. N. Winstead, C. B. Skotland and J. N. Sasser[1]

A cyst-forming nematode of the genus Heterodera has been found parasitizing soybean (Glycine max (L.) Merrill) in Southeastern North Carolina. Examination of soybean roots from small areas where the plants were severely stunted and chlorotic (Fig. 2), revealed the presence of numerous lemon-shaped female nematodes attached to the roots (Fig. 1). Soil samples from infested areas were found to contain several thousand cysts per pint of soil. Males were also very numerous.

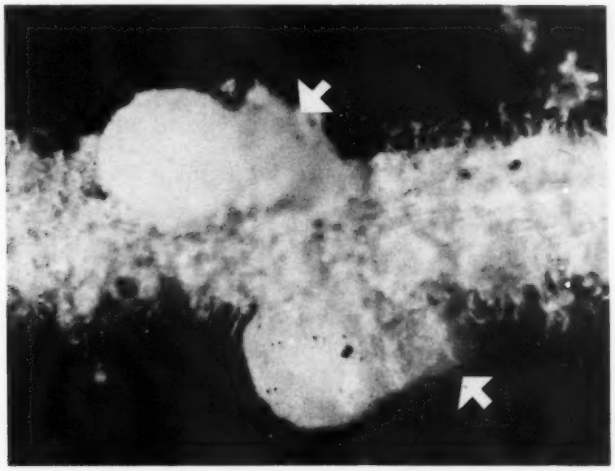

FIGURE 1. Soybean root showing attached female nematodes. Note egg masses (arrows) attached to the females. Approx. 37.5 x. (Photograph by Dr. C. J. Nusbaum).

This nematode has been tentatively identified as the soybean cyst nematode, Heterodera glycines Ichinohe, 1952[2, 3]. Two other Heterodera species are known to attack legumes -- the pea cyst nematode, H. göttingiana Liebscher, 1892, and the clover cyst nematode, H. schachtii trifolii Goffart, 1932. Mature cysts of the soybean cyst nematode can be distinguished from those of the pea cyst nematode by the presence of dark bodies (brown knobs) at the posterior end. These are absent in the pea cyst nematode. The clover cyst nematode apparently does not attack soybeans[4].

Investigations on the morphology and biology of the nematode, including field and laboratory experiments, are in progress. A survey is also being conducted to determine if the nema-

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1 Assistant Professor of Plant Pathology, Vegetable Research Laboratory, Castle Hayne, North Carolina, Plant Pathologist, Field Crops Research Branch, Agricultural Research Service, and Assistant Professor of Plant Pathology (Nematode Diseases), North Carolina State College, Raleigh, North Carolina, respectively.

2 Ichinohe, Minoru. 1952. On the soybean nematode Heterodera glycines n. sp. from Japan. Magazine of Applied Zoology 17: 1-4.

3 Specimens were sent to Mr. A. L. Taylor, Section of Nematology, Plant Industry Station, Beltsville, Maryland, for identification.

4 Gerdemann, J. W. and M. B. Linford. 1953. A cyst-forming nematode attacking clovers in Illinois. Phytopath. 43: 603-608.

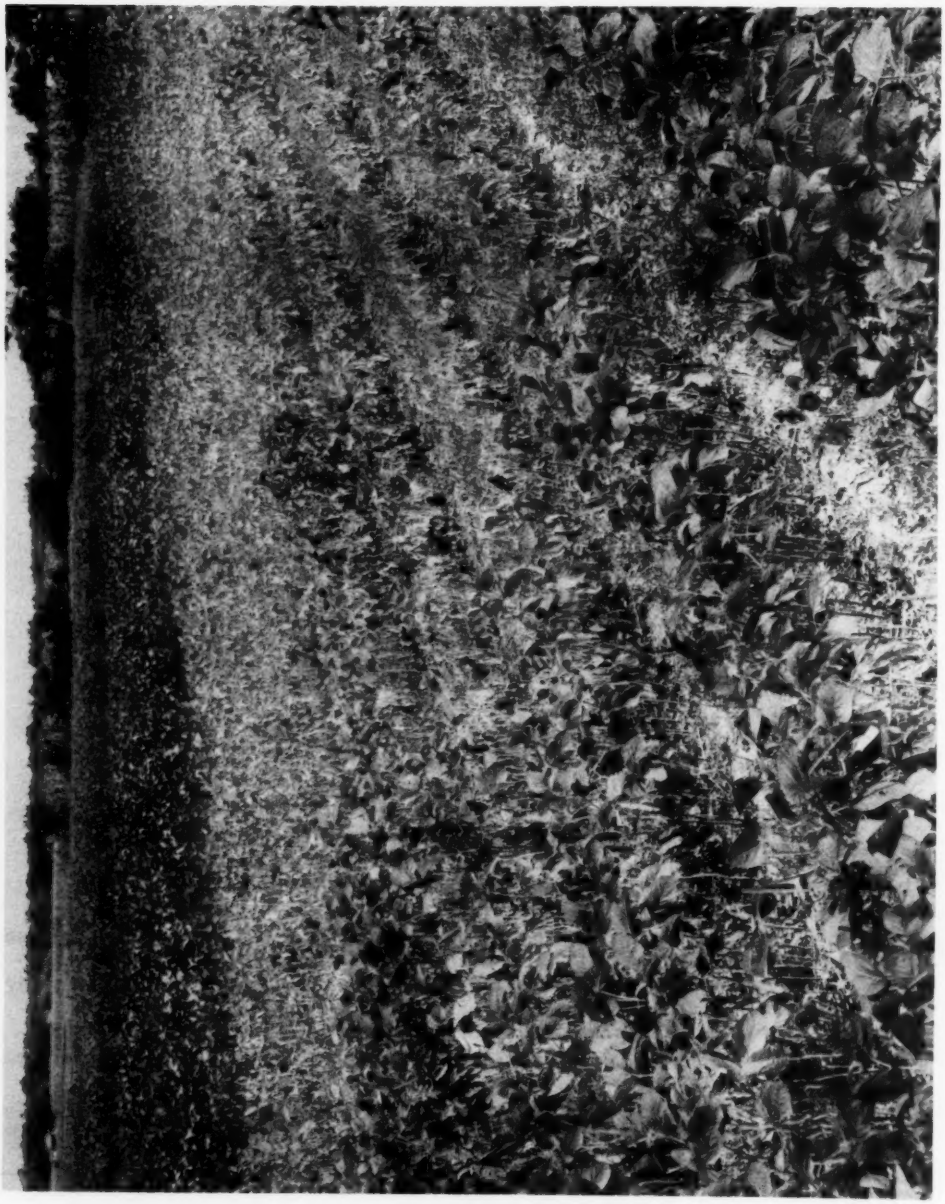

FIGURE 2. Soybean field infested with the soybean cyst nematode, Heterodera glycines. (Photographed by Mr. Ralph Mills).

tode is widespread in North Carolina. The known distribution of this species is Japan (Hokkaido, Honshu), and China (Manchuria)[2]. It has not been previously reported as occurring in the United States.

VEGETABLE RESEARCH LABORATORY, CASTLE HAYNE, NORTH CAROLINA, AGRICULTURAL RESEARCH SERVICE, U. S. DEPARTMENT OF AGRICULTURE, AND NORTH CAROLINA STATE COLLEGE, RALEIGH, NORTH CAROLINA

Heterodera glycines. (Photographed by Mr. Ralph Mills).

NEMATODES AND ROOT ROT DISEASES OF PERUVIAN COTTON

C. Bazán de Segura[1] and Pedro Aguilar F.[2]

Attack by the nematode Meloidogyne incognita var. acrita[3] has attained alarming proportions in Peru in recent years, especially in the Central Coastal region. The presence and increase of this organism are adding to the root disease complex of cotton.

Hitherto the most important problems with this crop have been wilt (Verticillium albo-atrum) and root rot (Thielaviopsis basicola). Although these two diseases were very serious they did permit the sprouting of ratoons from a considerable percentage of attacked plants, particularly of resistant varieties. During the last two years, however, we have observed that a much higher percentage of plants does not produce ratoons, susceptible varieties being most affected. In many cases replanting of whole fields is necessary, and other crops must be used because it is too late in the season to plant cotton again.

In the Hacienda Casablanca, Lurin Valley, it was possible to inspect a field of ratoon cotton with more than 60 percent of dead plants. From careful examination of 200 plants taken in a continuous line at three different points in the field we obtained the following data:

Attacked by	Sprouted		Not sprouted		Total	
	Number	Percent	Number	Percent	Number	Percent
Nematodes	46	57	0	0	46	23
Nematodes + Thielaviopsis	14	18	6	5	20	10
Nematodes + Verticillium	8	10	48	40	56	29
Nematodes + Thielaviopsis + Verticillium	12	15	66	55	78	38
Healthy	0	0	0	0	0	0
Total	80	40%	120	60%	200	100%

Nematode infection was generally light. Sprouted plants attacked by nematodes only were vigorous in appearance, whereas very weak or dying sprouts were associated with the combination of Meloidogyne and Verticillium, Meloidogyne and Thielaviopsis, or all three together. Of the dead (unsprouted) plants the majority were affected by the triple combination, in second place was Meloidogyne plus Verticillium, and last Meloidogyne plus Thielaviopsis.

On the other hand, many samples of dead cotton roots from the Chinch Valley received some weeks ago were severely attacked by nematodes without any symptoms of wilt or root rot.

These observations indicate that the nematodes alone, at a high rate of infection, cause the death of cotton plants; but, in addition, equally serious effects result from nematode injury to the roots and rootlets that facilitates the attack of other pathogens such as Verticillium and Thielaviopsis. Even resistant varieties become susceptible as a result of nematode damage.

In view of the importance of this problem Peruvian geneticists at the Estación Experimental Agricola de Cañete are developing selections from lines of Tanguis cotton resistant to nematodes.

ESTACIÓN EXPERIMENTAL AGRICOLA DE LA MOLINA, AND ASOCIACIÓN DE AGRICULTUORES DE LURIN, PERU

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[1] Sub-Jefe del Departamento de Fitopatologia de la Estación Experimental Agricola de la Molina.

[2] Jefe del Servicio de Entomologia de la Asociación de Agricultores de Lurin.

[3] Identified by A. L. Taylor, Nematologist, U. S. Department of Agriculture, Beltsville, Maryland, in samples of cotton roots from La Molina, Cañete, and Nasca.

TESTS WITH TWO ORGANIC MERCURIALS AGAINST THE GOLDEN NEMATODE OF POTATOES

Julius Feldmesser and Thelma Shafer

Screening of chemical dips and space fumigants capable of killing the contents of golden nematode, Heterodera rostochiensis, cysts found on roots of imported plant materials has been under investigation since 1950. Two progress reports have been published (1, 3).

In November 1952, a cooperative research project was begun at Hicksville, New York, to secure data on chemical dips lethal to the golden nematode found in association with imported bare-rooted plants. Of 252 chemicals that were screened in 13 months, the two most promising are "Aaventa" and "Aabulba"[1], organic mercurials in use as fungicidal dips in the Netherlands. Their value in the control of the golden nematode was first reported by Oostenbrink and Kuiper (2), who listed the following "Aaventa" dips as lethal to the larval contents of golden nematode cysts: 1.0% for 1 hour, 0.5% for three hours, and 0.25% for 6 hours. "Nearly complete kills" resulted from "Aaventa" dips at 2.0% for 30 minutes and at 0.125% for 24 hours. After treatments, cysts were washed in tap water for 4 minutes. Viability readings were made over periods of several weeks after treatment. "Aabulba" was judged to be more effective than "Aaventa". Phytotoxicity tests indicated that narcissus, iris, crocus, hyacinth, gladiolus, and tulip (the Dillenburg variety) could tolerate "Aaventa" treatments lethal to the nematode.

The present report concerns 280 tests with these two organic mercurials made on Long Island, New York. Results of some of these tests confirm the conclusions of Oostenbrink and Kuiper, and others determine new lethal dosages. In addition, phytotoxicity studies were made.

A total of 120 separate tests confirmed the value of the 1.0%, 0.5%, and 0.25% treatments. However, in 22 tests the 0.125% dips for 6 hours were also lethal. In addition, 2.0% for 10 minutes was judged to be a lethal treatment.

Phytotoxicity studies indicated that treatments lethal to the nematode were toxic to Convallaria pips, Kaempferia, and Dahlia, but were tolerated by Gladiolus, Amaryllis, tuberoses, and Chrysanthemum. In addition, potted Gardenia showed no toxic effects other than slight inhibition of root growth, three months after 1.0% drenches had been applied. The tolerances of a large number of ornamental plants are now being investigated.

Literature Cited

1. Feldmesser, Julius, George Fassuliotis, and F. J. Spruyt. 1951. Investigations on control of the golden nematode of potatoes. Plant Dis. Reptr. 35: 515-518.
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3. Richardson, Henry H., and F. J. Spruyt. 1951. Quarantine treatments to control golden nematode cyst adhering to lily-of the-valley pips: progress report with special reference to plant tolerance. Plant Dis. Reptr. 35: 519-521.

HORTICULTURAL CROPS RESEARCH BRANCH AND ENTOMOLOGY RESEARCH BRANCH IN COOPERATION WITH THE PLANT PEST CONTROL BRANCH, AGRICULTURAL RESEARCH SERVICE, U. S. DEPARTMENT OF AGRICULTURE

[1] Manufactured by Landbouwbureau M. Wiersum, Groningen, The Netherlands. Samples were made available through the kind cooperation of Mr. A. Springer, Asscoiated Bulb Growers of Holland, 25 Broadway, New York City.

CONTROL OF TOBACCO WILDFIRE WITH STREPTOMYCIN PREPARATIONS

R. S. Kirby

Streptomycin sulfate 15% plus Terramycin 1.5% (Agrimycin), applied to tobacco seedbeds in combination with ferbam, prevented the development of wildfire (Pseudomonas tabaci) in the seedbed and reduced the amount of wildfire developing in the field; and when applied to previously infected plants in beds, checked the spread of wildfire and enabled the infected plants to grow normally. Three series of beds in Lancaster County, Pennsylvania, were used in the trials.

1. Preventive Treatment: Fifty square yards in the center of a plant bed received four weekly spray applications of Agrimycin 100 ppm plus ferbam 3 pounds per 100 gallons, starting when the plant leaves were the size of a dime. In the part sprayed with the antibiotic-ferbam combination none of the plants became infected, whereas wildfire attacked about 10 percent of the plants in the unsprayed ends of the beds. At harvest time, 41 percent of the plants from the unsprayed parts of the beds had wildfire, whereas less than 20 percent of the plants from the sprayed parts showed traces of wildfire.

2. Treatment of Previously Infected Plants: In plant beds with from 5 to 50 percent of the plants infected, four sections, 20 feet long, received four weekly sprays. Ferbam 3 pounds per 100 gallons plus Agrimycin 100 or 200 ppm was used in all sprays. The grower sprayed the remainder of the plants with a Bordeaux and ferbam program. In all sections sprayed with the antibiotic the spread of wildfire was checked and the plants grew more rapidly. In the area of heaviest infection where Agrimycin at 200 ppm was used wildfire was checked and a full crop of tobacco plants free of wildfire was obtained. Blue mold (Peronospora tabacina) was rather severe except where Agrimycin-ferbam was applied.

PENNSYLVANIA STATE UNIVERSITY, COLLEGE OF AGRICULTURE, DIVISION OF AGRICULTURE EXTENSION

TOBACCO WILDFIRE CONTROL BY STREPTOMYCIN NITRATE[1]

W. S. Beach and H. B. Engle

An experiment to test streptomycin nitrate for control of wildfire was conducted in a tobacco plant bed at the southeastern field research laboratory, the Pennsylvania State University and the U. S. Department of Agriculture cooperating, Landisville, Pennsylvania, during the spring of 1954. The streptomycin nitrate was sample solution B-2730 furnished by the Mathieson Chemical Corporation. Tobacco seedlings were sprayed with a mixture of one ounce of sample solution in 9.4 gallons of water, or 100 ppm of streptomycin. A gallon covered approximately 10 square yards at each application.

The tobacco was the wildfire-susceptible variety Swarr-Hibshman of Pennsylvania broadleaf. The experimental area was sprayed once when the plants were in the seed leaf stage with a virulent culture of Pseudomonas tabaci grown in potato-dextrose broth. This was diluted 6 times with water before being applied to the plants.

FIGURE 1. Wildfire-susceptible Swarr-Hibshman tobacco variety inoculated with Pseudomonas tabaci. Right, not treated after inoculation. Left, inoculation followed by treatment with streptomycin nitrate.

The first application of the streptomycin nitrate was made the day following the application of the bacteria. The check area was 4 square yards of bed which received the bacteria but not the antibiotic. Three subsequent applications of the antibiotic were made, each after an interval of 8 to 10 days. The antibiotic applications were on the same dates as those of bordeaux made upon other experimental beds. All bed areas received four applications of 3-100 Fermate for blue mold control, these being time-spaced between those of streptomycin nitrate, or bordeaux.

Seedling stands of the susceptible Swarr-Hibshman tobacco may be virtually destroyed by spraying with cultures of P. tabaci when conditions favor wildfire. Only a few infected and stunted plants may remain. This is shown in the check area (Fig. 1, right). The plants that received the streptomycin nitrate treatment, (Fig. 1 left) made normal growth. They were vigorous and free from disease except for a few scattered wildfire leaf spots mostly along the line dividing the treated and untreated areas.

The control of wildfire given by the streptomycin nitrate was superior to that obtained with bordeaux, which is not very efficient in preventing infection if application is made following

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[1] Contribution No. 193 of the Department of Botany and Plant Pathology, The Pennsylvania Agricultural Experiment Station.

plant inoculation or the occurrence of some disease. These results are in line with those reported for streptomycin sulfate by Heggestad and Clayton (Plant Disease Reporter, Vol. 38, No. 9, pp. 661-669. Sept. 1954).

PENNSYLVANIA AGRICULTURAL EXPERIMENT STATION

SMALL GRAIN DISEASES IN GEORGIA IN 1953-54[1]

J. H. Miller, U. R. Gore, A. R. Brown and D. D. Morey

The winter temperatures were unusually mild over most of the State. April was above normal and May much below. Rainfall was very heavy in December and unusually light for the rest of the grain season. May was especially dry as well as cold. Some diseases were in serious proportions that had not been observed for several years.

WHEAT

Leaf-rust (Puccinia rubigo-vera tritici) was widespread, but the peak of infection arrived late and the loss was less than usual except in isolated cases. In northeast Georgia there was only a trace up to the middle of April, but the disease was severe the last week in May just before wheat ripened. In most of the State leaf rust on Chancellor varied from only a trace when mature to 100 percent in some fields. Some fields of Coker 47-27 showed very little but one field had 80 percent. A few fields of Redhart and of Atlas 50 had only a trace when mature. In the Agronomy Plots, Clarke County, Chancellor showed 43 percent, Atlas 20 percent, Taylor 5 percent, Coastal 3 percent, and Anderson and Coker 47-27 only a trace. Race 122, which attacks Chancellor, the leading variety, has been present in the State for some time and is widespread. The occurrence of leaf rust on Atlas 50 is disturbing, since hybrids of Frondosa, Fronteira, and Supresa parentage have shown high resistance. At the Mountain Station rust was present on Thorne, Chancellor, Sanford, and Atlas, but was not serious. In southern Georgia, near Tifton, rust appeared on Purple Straw as early as February 25 and on other varieties later.

Stem rust (Puccinia graminis tritici) appeared as a trace at the very last of the season and caused almost no loss. The only report of much infection was in the Tifton plots where stem rust was heavy on susceptible varieties.

Loose smut (Ustilago tritici) was about as usual in farm fields, from 1 to 2 percent, but in plots at Experiment it was unusually severe, especially on Coastal and Coker 47-27.

Powdery mildew (Erysiphe graminis tritici) was the chief disease in most of the wheat fields this year. By the middle of April Chancellor showed 2 to 20 percent leaf loss and in one field in Hart County the leaves were yellow clear to the top on April 22. Powdery mildew was the chief wheat disease in the plots at Experiment also. FW 815-X-2 showed highest resistance of all varieties tested. Atlas 50 had satisfactory resistance.

Hessian fly (Phytophaga destructor) in some localities appeared in noticeable proportions for the first time since 1949. In parts of Madison County lodging varied from 5 to 20 percent, in Jackson County from 1 to 2 percent. Near Calhoun, Georgia, a September planting of Chancellor showed 20 percent infestation on December 1; at Plains there was a 75 to 100 percent reduction in stand on January 26, also on early-sown wheat; and heavy damage was observed in one field near Americus on the same date.

Minor Diseases. Leaf and glume blotch due to Septoria tritici and S. nodorum were very evident in the Tifton plots February 10, and in north Georgia fields by April 16. Leaf spotting (Helminthosporium tritici-repentis) was observed in one field of Chancellor wheat in Madison County on May 24.

Twist (Dilophospora alopecuri) was observed in a 10-acre field of Chancellor in Hart County March 16. The stand was ruined and subsequently plowed up. The wheat nematode (Anguina tritici) was associated with the fungus in the hypertrophied leaf areas. This is apparently the first Georgia observation of twist.

The wheat nematode was reported in a field near Tifton. One lot of wheat in Spalding County contained 20 percent galls. A very small percentage of the wheat samples submitted to the Grain Grading Laboratory at the University of Georgia this past summer showed nematode galls.

OATS

Crown rust (Puccinia coronata). In north Georgia only a trace was found in a few fields as late as May 19. In the Athens plots Southland and Stanton showed 10 percent infection on May 25. Near Sparta one field of Fulgrain was heavily infected November 25 with crown rust iden-

[1] Approved as journal paper No. 16 of the College Experiment Station.

tified as race 213. In the mountain area near Blairsville spring-sown oats were damaged and heavy rust was noted on Columbia. It was also present on Atlantic, Forkedeer, and LeConte varieties. The dry spring probably accounted for the slight loss over most of the State.

Stem rust (Puccinia graminis avenae) was found only at Tifton and in the plots at Athens. Heavy infection followed artificial inoculation in a Tifton nursery. None of the varieties tested showed resistance. Tennessee selections 286-8 and 313-2 were the only ones with appreciable rust, about 60 percent on May 25, in the Athens plots.

Loose smut (Ustilago avenae). A trace was observed in most fields, but in only one (Madison County) was infection as high as 10 percent.

Victoria blight (Helminthosporium victoriae). In Oconee County in one field of Victorgrain, April 16, isolated spots were found with weak, stunted plants, and in another where there had been no rotation 1 to 2 percent were dying with crown or culm rot. On May 19, in same county and variety, one field showed 5 percent lodging, and in one spring-planted field the dying was 66 percent. The latter plants showed the described marginal leaf striping as well as crown rot. Another field of Victorgrain in Jefferson County showed 10 percent lodging. In the Athens plots Fulgrain showed 15 percent lodging and Atlantic had a trace. In many other fields inspected in the State none of this blight was found. This is the first year in several that more than a trace has been found in any field.

Crown or culm rot (Helminthosporium sativum). A Victorgrain field in Oconee County showed a trace on basal leaves April 16, and a trace was found in Madison County May 24. In Jefferson County a field of Southland showed 15 percent lodging in early May. Several other fields in that county had traces. Near Tifton culm rot reduced stands in the fall but was not serious in the spring. Except for isolated fields this disease was not important in the State as a whole.

Leaf spot (Helminthosporium avenae) was observed in all fields inspected, but the incidence was less than usual. Only a few fields in late fall or winter had the reddish or brownish appearance often seen from severe infections.

Anthracnose (Colletotrichum graminicola) was found late in the season after plants had fully matured in most fields, but in only one, of Victorgrain, was the lodging as much as 10 percent.

Downy mildew (Sclerospora macrospora) was found in one Southland field in a river bottom between Georgetown, Georgia, and Eufala, Alabama. About 5 acres was so badly affected it would not produce grain.

Virus diseases: Soil-borne virus of oats was first noticed at Experiment in 1942. Four fields used in rotation for small grains have since shown heavy mosaic. This year at the Athens Agronomy plots C.I. 6666 and C.I. 6574 showed 40 percent mosaic.

In one Arlington oat field, Oconee County, a yellow flecking and striping without noticeable dwarfing was observed. The cause was not determined, but could be a virus origin.

Aphids (Toxoptera graminum) were very serious in the coastal plain and along with the dry weather ruined many stands. Several acres in the piedmont, in Spalding County, were completely destroyed.

RYE

Leaf rust (Puccinia rubigo-vera secalis) was found in the Tifton clipping plots on November 28. During May a small percentage of leaf rust was found in all fields inspected.

Stem rust (Puccinia graminis secalis). In the Athens plots rye showed 10 percent May 25. An Abruzzi selection, Gurley, from Mississippi, was most susceptible.

Powdery mildew (Erysiphe graminis secalis) was observed in a pasture near Tifton on January 28.

Leaf spot (Helminthosporium tritici-repentis) was also found near Tifton.

BARLEY

Powdery mildew (Erysiphe graminis). In Hart County on variety Calhoun, 40 percent of the leaf area was destroyed April 16, soon after top dressing with nitrate of soda.

Loose smut (Ustilago nuda) averaged from 5 to 30 percent on farm fields of Calhoun. This disease has discouraged barley growing. Where hot-water treatment has been used the germination has been reduced below a practical point.

In the barley plots at Athens the following diseases were evident:

Helminthosporium sativum and H. teres with a trace of spotting on Calhoun.

Helminthosporium gramineum, stripe, severe on C.I. 4356 and Brugh 76 in the world col-

lection of barleys.

Rhynchosporium secalis, a trace of scald on all varieties.
Ustilago nuda, loose smut, trace to 2 percent on all varieties.
Puccinia hordei, leaf rust selection Y146, showed 40 percent damage.
Physiological spotting was severe on Colonial 2.

GEORGIA AGRICULTURAL EXPERIMENT STATIONS, COLLEGE EXPERIMENT STATION, ATHENS, GEORGIA

A NEW METHOD OF CONTROLLING LOOSE SMUT OF BARLEY

T. T. Hebert

SUMMARY

Loose smut of barley can be effectively controlled by holding soaked seed in air-tight containers. The length of anaerobic treatment necessary is inversely related to temperature. Control of smut was obtained when containers were only half filled with soaked seed. No appreciable reduction in germination resulted from these treatments. A soaking period of only 2 hours in water gave control. Grain soaked for such a short time would be easier to dry than grain held for long periods in water or Spergon suspensions.

In 1951 Tyner[1] reported control of loose smut of barley (Ustilago nuda (Jens.) Rostr.) by presoaking infected seed for 6 hours in water and then immersing it in a 0.2% suspension of Spergon SL (chloranil) for 40 hours at room temperature (72° F.). In 1953 he reported that soaking in water alone for 56 to 64 hours also controlled the smut effectively[2].

At the time of Tyner's first report the author was engaged in trying to develop a method of smut control by soaking the seed in fungicidal solutions for 6 hours. Most of the commercial fungicides and a number of experimental fungicides were tested, but none gave complete control of the smut without excessive reduction of seed germination. In 1951-52 the Spergon treatment reported by Tyner was tried on infected Colonial barley seed at room temperature (25° to 30° C.). Under these conditions the Spergon treatment controlled smut but reduced seed germination to less than 50 percent. Soaking the seed in water alone for 46 hours gave good control of the smut with much less reduction in germination of the seed. The water in which the barley had been soaked was quite turbid from the growth of microorganisms, principally bacteria, and had a foul odor.

An experiment was conducted in 1952-53 to determine whether the control of smut by soaking in water was due to antibiotic substances produced by the microoroganisms in the water or to the anaerobic condition of the soaked seed. One lot of barley seed infected with loose smut was divided into two portions. One portion was disinfested in a formaldehyde solution, rinsed, and soaked for 6 hours, using sterile water. The other portion was soaked in tap water for 6 hours. Each lot was further subdivided. One portion was drained, placed in 25 x 250 mm. test tubes and closed with rubber stoppers. The other portion was spread in a thin layer on paper towels and dried for one hour with a fan before being placed in the tubes. This treatment removed the free water from the surface of the grain. The seed was kept in the tubes at room temperature (25° to 30° C.) for varying intervals of time up to 60 hours. It was then dried and planted in two replicated 5-ft. rows. After the barley headed, each row was examined for presence of smut. The results are given in Table 1.

Smut control appeared to be associated with anaerobiosis rather than the activity of microorganisms. Surface disinfestation and drying of the seed had no effect on smut control.

Further studies of this anaerobic method of controlling smut were made in 1953-54. In the following experiments, unless otherwise stated, infected barley seed was soaked in tap water for 6 hours at 25° to 30°C., drained, placed in 25 x 250 mm. test tubes and closed with rubber stoppers. After varying intervals of time at 25° to 30° C., the barley was removed from the tubes, dried, and stored for 3 to 5 weeks in coin envelopes. It was then planted in two replicated 5-ft. rows in the field. After the barley headed, the number of smutted heads in each row were counted.

No germination counts were made. However, samples of 100 to 150 seeds from each treatment were germinated on moist paper toweling in the laboratory and compared visually with samples of untreated seed. A comparison was also made of stands obtained with treated and untreated seed in the field. There were no appreciable differences in germination between treated and untreated seed with the exception that anaerobic treatment at 32° C for 54 hours reduced germination by about 20 percent.

One of the problems involved in the long-water-soak method is the difficulty of drying the

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1 Tyner, L. E. 1951. Control of loose smut of barley by chemical and physical treatments. Sci. Agr. 31: 187-192.

2 _____. 1953. The control of loose smut of barley and wheat by Spergon and by soaking in water at room temperature. Phytopath. 43: 313-316.

Table 1. Control of loose smut in barley soaked in water for 6 hours, drained and held in stoppered tubes, 1952-1953.

Treatment	Presence or absence of smut after indicated number of hours in tubes									
	0		18		40		48		60	
Seed disinfested										
Surface dried	+	+[a]	+	+	0	0	0	0	0	0
Surface not dried	+	+	+	+	0	0	0	0	0	0
Seed not disinfested										
Surface dried	+	+	+	+	0	0	0	0	0	0
Surface not dried	+	+	+	+	0	0	0	0	0	0

[a] + = smut present, 0 = smut absent.

Table 2. Control of barley loose smut by 6-, 4- and 2-hour soaking periods prior to anaerobic treatment.

Length of soaking period	Smutted heads per 10 ft. row after indicated number of hours in closed tubes			
	24	36	48	60
6 hours	12	6	1	0
4 hours	17	3	0	0
2 hours	15	6	3	0

Table 3. Effect of quantity of soaked barley seed in closed tubes on loose smut control.

Amount of grain	Smutted heads per 10 ft. row after indicated number of hours in closed tubes			
	22	31	42	54
Tube full	19	6	0	0
Tube 3/4 full	15	4	0	0
Tube 1/2 full	15	1	0	0
Tube 1/4 full	21	15	1	0

Table 4. Effect of temperature during anaerobic treatment on the length of time required to control loose smut of barley.

Temperature (°C.)	Smutted heads per 10-ft. row after indicated number of hours in closed tubes			
	22	31	42	54
20	19	12	12	5
24	15	14	0	0
28	12	0	0	0
32	0	0	0	0

grain after treatment. Shorter soaking periods would minimize this problem. An experiment was conducted using 6-, 4- and 2-hour soaking periods before placing the grain in test tubes.

It is apparent from Table 2 that a soaking period of only 2 hours is sufficient to eliminate smut. Experiments are in progress to see if smut control can be obtained with even shorter soaking periods.

Since soaked barley seed germinates rapidly when given a sufficient supply of oxygen, an effort was made to determine what proportion of air could be left in a container without inducing germination or affecting smut control. Infected barley seed was soaked and placed in test tubes in varying quantities with results as shown on Table 3.

Smut was controlled with as little as one-fourth of the container filled with barley. However, the pathogen was eliminated more slowly with the larger supply of air. No germination occurred during treatment.

The effect of temperature on the length of time required to eliminate smut was next studied. Infected barley was soaked, placed in tubes and held at 20°, 24°, 28°, and 32° C., for 22, 31, 42 and 54 hours.

Smut was controlled in 22 hours at 32° C., while at 20°, even 54 hours did not completely eliminate smut (Table 4). At 24° and 28°, complete control was obtained in 42 and 31 hours, respectively.

PLANT PATHOLOGY, NORTH CAROLINA STATE COLLEGE, RALEIGH, NORTH CAROLINA

PURIFICATION OF DIFFERENTIAL OAT VARIETIES FOR IDENTIFICATION OF RACES OF CROWN RUST[1]

M. D. Simons, B. Peturson, and H. C. Murphy

The available stocks of seed of the 10 new differential varieties of oats[2] used for identification of races of crown rust (Puccinia coronata) were known to be impure. Seed of some of the varieties was so badly mixed that race identification was, in some cases, seriously hampered. With this in mind, the writers undertook to establish and increase pure lines of each of the differential varieties to serve as foundation stock for the use of pathologists throughout the world.

Seven of the ten differential varieties (Anthony, Victoria, Appler, Landhafer, Ukraine, Bondvic, and Saia) were "relatively" pure, both for reaction to crown rust and for grain type. Five typical seeds of each of these varieties were selected.

Bond usually appeared to be homogeneous for crown rust reaction, but, when viewed under ultraviolet light[3] the seed available was seen to be composed of about equal parts of brightly fluorescing and non-fluorescing grain. Santa Fe comprised a mixture containing mainly white, reddish-yellow, and gray kernels. Trispernia was composed of white, gray, and dark-gray grain. Five seeds of each of the major constitutents of Bond, Santa Fe, and Trispernia were selected.

Table 1. Seedling reactions[a] of selected pure lines of the 10 new differential varieties of oats to 5 races of crown rust at Ames, Iowa.

Variety	C.I. No.	Diff. No.	Race				
			202	203	205	216	258
Anthony	7001	101	4	4	4	4-	4
Victoria	7002	102	2	1	I	4	4-
Appler	7003	103	4	4	4	4	4
Bond	7004	104	4	4	4	4	0
Landhafer	7005	105	0	0	0	0	0-
Santa Fe	7006	106	0	0	I	0	0-
Ukraine	7007	107	0, 1	4	0	4	0
Trispernia	7008	108	0	0	0-	0, 1	0
Bondvic	7009	109	0, 1	0, 1	0	2	0
Saia	7010	110	0	0	4	0	I

[a] "I" indicates no macroscopic evidence of infection; "0", necrosis or chlorosis, but no uredia; "1", necrotic or chlorotic areas, some of which contain small uredia; "2", necrotic or chlorotic areas, most of which contain small to mid-sized uredia; "3", chlorotic areas surrounding abundant, mid-sized uredia, no necrosis; "4", no necrosis or chlorosis, uredia large and abundant.

The seed selected was space-planted at Aberdeen, Idaho, in 1953, and the plants were examined for conformity to their respective varietal characteristics. All the plants were harvested and threshed individually, using care to keep the seed from each plant free from admixtures. Each of these single plant progenies was then tested for reaction to different races of crown rust in the first leaf stage, in greenhouses at Ames, Iowa, and Winnipeg, Manitoba.

At Ames pure cultures of 5 races of crown rust (Table 1), each derived from a single

[1] Cooperative investigation between the Field Crops Research Branch, Agricultural Research Service, U. S. Department of Agriculture; Iowa Agricultural Experiment Station; and Cereal Division, Department of Agriculture, Canada. Journal Paper No. 2646 of the Iowa Agricultural Experiment Station, Ames, Iowa, Project 1176.

[2] Simons, M. D. and H. C. Murphy. (In press). A comparison of the relative efficiency of certain combinations of oat varieties in differentiating races of crown rust. U. S. Dept. Agr. Tech. Bul.

[3] Finkner, R. E., H. C. Murphy, R. E. Atkins, and D. W. West. 1954. Varietal reaction and inheritance of fluorescence in oats. Agron. Jour. 46: 270-274.

uredium, were used. With the exception of the Santa Fe and Trispernia varieties, all the progenies of a variety reacted similarly to given races. Part of the progenies derived from the white seeds of Santa Fe were uniformly highly resistant to all races. Other progenies from white seeds and all progenies from reddish-yellow and gray seeds of this variety showed at least moderate susceptibility to one or more of the races used. All progenies selected from Trispernia were classified as resistant to all 5 races, but showed a considerable variation in degree of resistance.

Table 2. Seed characteristics of selected pure lines of the 10 new differential varieties of oats used to identify races of crown rust.

Variety	Diff. No.	C.I. No. of parent variety	C.I. No. of pure line	Seed characteristics[a]		
				Color	Taxonomic type	Fluorescence under ultra-violet light
Anthony	101	2143	7001	White	Avena sativa	Bright
Victoria	102	2401	7002	Reddish-yellow	Avena byzantina[a]	Bright
Appler	103	1815	7003	Red	Avena byzantina	Bright
Bond	104	2733	7004	Reddish-yellow	Avena byzantina	None
Landhafer	105	3522	7005	Red	Avena byzantina	Bright
Santa Fe	106	4519	7006	Grayish-ivory	Avena byzantina[b]	Bright
Ukraine	107	3259	7007	Ivory-yellow	Avena sativa	Bright
Trispernia	108	4009	7008	Gray	Avena byzantina	Moderate
Bondvic	109	5401	7009	Gray	Avena sativa	Moderate
Saia	110	4639	7010	Dark gray	Avena strigosa	None[c]

[a] Seed grown at Aberdeen, Idaho, under irrigation. Seed characteristics, especially color, are somewhat dependent upon the environment under which the seed is produced.

[b] Intermediate, in some respects, between Avena byzantina and A. sativa.

[c] Veins of lemma fluoresce. Areas between the veins do not.

Using all the pathological and morphological data available, 1 single-plant progeny of each of the 10 varieties was selected. The remnant seed of these 10 lines was increased at Aberdeen, Idaho, in 1954, where the plants were again examined. All the lines were typical representatives of their respective varieties with the possible exception of Santa Fe, which appeared to be a little earlier and shorter than the unselected variety. A good increase of seed of each line was obtained in 1954, and the lines were assigned the C.I. numbers shown in Table 2. Further increases will be made at Aberdeen in 1955. Seed of these selected lines will be available upon request to the senior author at any time after the autumn of 1955.

FIELD CROPS RESEARCH BRANCH, AGRICULTURAL RESEARCH SERVICE, U. S. DEPARTMENT OF AGRICULTURE, AND IOWA AGRICULTURAL EXPERIMENT STATION, AMES, IOWA, AND CEREAL DIVISION, DEPARTMENT OF AGRICULTURE, WINNIPEG, MANITOBA, CANADA

TESTING FOR RESISTANCE TO THE SEPTORIA DISEASE OF OATS[1]

M. D. Huffman

The disease caused by Septoria avenae Frank (Leptosphaeria avenaria Weber) was first described as a leaf spot on oats by Frank (2) in Pomerania, Germany in 1895. It was more fully described and the disease symptoms and expression elucidated by Weber (9) in 1922 at Madison, Wisconsin. It was not, however, considered to be economically important at that time. In 1949 Meehan and Murphy (6) described a stem blackening of oats caused by Septoria avenae which caused culm rotting and severe lodging in some varieties in Iowa. Since that time the black stem phase has been reported throughout the North Central States as a serious disease of oats.

Since 1949 a search has been under way to find possible sources of resistance to the disease. Goto (3) of Minnesota, Poole and Murphy (8) of Iowa, and Lund and Shands (5) of Wisconsin, as well as Derick (1) of Canada have reported on results of tests for resistance. In no case has immunity, or even high resistance, been reported. In each report some strains were described as possessing relatively greater resistance than others. Testing has been done by various means, utilizing both artificial and natural infection and a range of different types of inoculum and application. In 1953 tests were initiated to search for possible sources of resistance in the C.I. oat collection. Inoculation procedures were developed in the laboratory and greenhouse and tested in the field that summer. The results of these tests for the two-year period 1953-1954 are reported herein.

Inoculation Procedures

The first problem in such a screening program is the choice of a suitable type of inoculum. Prior to this investigation three methods of inoculation had been employed in the field. Weber (9) used conidia in water suspension. Most of his inoculum was obtained by crushing the pycnidia occurring on oat leaves and using a water suspension of the spores. His results were somewhat contradictory but in general very satisfactory. Goto (3) also used spore suspensions and obtained rather consistent results. Because of the difficulty of obtaining enough spores for large quantities of inoculum, Meehan and Murphy (6) used mycelial suspensions. Good infection was obtained in this manner. Poole (7) used mycelial suspensions for spraying and hypodermic injection, as well as a glass tube around the culm which was plugged with cotton soaked in mycelial suspension. However, the latter method was used only in the greenhouse because of the amount of hand labor involved in preparing such an arrangement. Lund (4) applied both spores and mycelial suspensions as sprays and as hypodermic injections. Again, the inavailability of an adequate source of spores prevented their use as field inoculum. In all of these methods it was found that high humidity was necessary for infection.

In choosing a type of inoculum for use in the field several factors were taken into consideration. The most important of these was that the method of inoculation simulate that of natural infection as closely as possible. It was reasoned that the initial natural infection was probably due to some type of spore and for that reason spores would be the most favorable inoculum. In addition to being more like the natural method of infection, the use of spores facilitated the control of spore load used in inoculation, and caused much less clogging of the spray line than did mycelium. The use of hypodermic injection was rejected from the beginning for two reasons: the manual labor involved in injecting inoculum into each plant when dealing with thousands of strains of the host made the method impractical, and, with a facultative parasite such as S. avenae, it was considered that such hypodermic injection merely constituted a growing of the fungus in culture, and as such was not an accurate method for evaluating resistance.

After the choice of spores as inoculum was made, the problem of producing the necessary quantities was encountered. The difficulty of maintaining sporulating cultures had been one of the prime factors necessitating the use of mycelial suspensions as inoculum by former workers. In fresh isolations from oats a few pycnidial fruiting bodies were produced in culture, but after one or two transfers sporulation ceased entirely. Such loss of sporulation was described by Lund (4).

In this work approximately a dozen different basic media and a number of variations from these were tested unsuccessfully in attempts to induce sporulation. A successful method was

[1] Journal paper No. J-2651 of the Iowa Agricultural Experiment Station, Ames, Iowa. Project No. 1176.

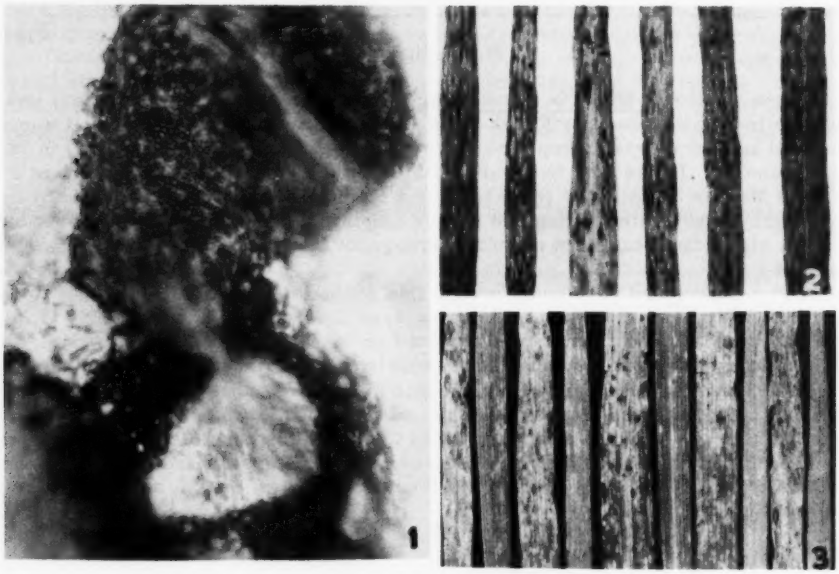

FIGURE 1. Macropycnidium of Septoria avenae showing cirrhus of spores exuded through ostiole (x about 360).

FIGURE 2. Representative leaves showing percentage of leaf lesions used as a scale for determining extent of leaf infection. Percent, left to right: 1 -- 0-10, 2 -- 20, 3 -- 30, 4 -- 40, 5 -- 50, 6 -- 60-70.

FIGURE 3. Representative leaves of selections showing resistance to Septoria alternated with leaves of the susceptible variety Cherokee. Left to right: Cherokee, C.I. 3918; Cherokee, C.I. 3948; Cherokee, C.I. 4040; Cherokee, C.I. 4439; Cherokee, C.I. 4440.

finally developed, as follows: Sterilized oat stems suspended in distilled water in test tubes were inoculated, resulting in limited sporulation. The pycnidia produced on these straws were crushed in a sterile water blank and this spore suspension was poured over the surface of a medium prepared from green oat leaves. In approximately 5 days dots of flesh colored exudate were noticed in nearly all cultures and upon examination were found to be conidia exuded through the ostioles of the pycnidia. Subsequent cultures on this medium, initiated by spore suspensions, continued to yield abundant inoculum (Fig. 1). Transfers were made from the test tubes to 500 cc. glass bottles from which the spores were obtained by flooding with water. The spores in suspension were well suited for use as inoculum, and in preliminary greenhouse tests produced typical leaf spot symptoms. The preparation and ingredients of the green oat leaf agar were as follows:

300 grams of fresh green oat leaves
12-15 grams of agar
100 cc. distilled water

The leaves were pulverized or ground to express the juice. Juices and pulp were then added to 1000 cc. distilled water containing the agar. This material was boiled for 5 minutes, strained through cheesecloth, and tubed and autoclaved for approximately 15 minutes at 15 pounds pressure.

When sporulation was achieved, all transfers were made by spore suspension. All attempts to perpetuate sporulation by mycelial transfer failed.

In the greenhouse the spore suspension was applied to plants with a hand atomizer. Following inoculation the plants were placed in a moist chamber for 12-24 hours at a temperature from 60° to 70° F. A 12-hour inocubation period in the moist chamber was as effective in in-

Table 1. Leaf spot reactions[a] to Septoria avenae in the field in 1953-54 as compared with the variety Cherokee.

Strain	C.I. No.	1953		1954					Mean
		Ames	Ames	Ames	Ames	Ames	Ames	Kanawha	
Cherokee	3846	5	4	4	4	5	4	6	4.6
Clintafe	5869	2	2	3	3	3	3	3	2.7
	1003	1	1	1	1	2	4	4	2.0*
	2927	1	2	2	1	1	2	5	2.0*
	3387	2	1	1	1	1	4	4	2.0*
	3945	2	1	1	1	2	4	3	2.0*
	3949	2	1	1	1	1	4	4	2.0*
	4042	1	1	1	1	2	4	4	2.0*
	4439	0	0	1	2	2	5	4	2.0*
	4441	1	1	2	0	2	4	4	2.0*
	3918	1	0	1	1	0	5	5	1.9*
	3946	2	1	1	2	2	2	3	1.9*
	4040	0	0	0	3	2	5	3	1.9*
	4043	1	1	1	2	2	2	4	1.9*
	4047	1	1	0	1	3	3	4	1.0*
	4440	1	0	0	0	2	5	5	1.9*
	3400	2	1	0	2	2	2	3	1.7*
	3929	2	0	1	1	1	3	4	1.7*
	3922	2	1	2	1	1	1	3	1.6**
	3930	1	1	0	1	1	2	3	1.3**
	3948	0	0	0	1	1	3	4	1.3**
	5977	2	1	0	0	0	2	4	1.3**
	3928	2	0	0	1	0	2	3	1.1**
	6572	2	1	1	0	0	2	2	1.1**
	6583	1	0	2	0	0	2	2	1.0**

* Denotes significance at 5% level.
** Denotes significance at 1% level.
[a] See Fig. 2.

ducing infection as a longer period.

For field inoculation a Hudson Junior stainless steel knapsack sprayer was used. The inoculum was applied near sundown about two weeks in advance of the time when symptoms resulting from natural infection generally occur. This timing was used because of the 12-14 day incubation period which was described by Weber (9). Inoculation in the evening was timed so that the water droplets from the spray stayed on the leaves in bead form until dew formed. At the proper time for inoculation in Iowa dew remains on the plants from 12 to 14 hours, which is long enough at high humidity to result in good infection. No other means of raising humidity was necessary if inoculation was synchronized with the dew period.

Observation of Symptoms

About two weeks following inoculation the leaf spotting was sufficiently developed to permit observation of leaf spot symptoms. Spore load was regulated so that the variety Cherokee would show about 50 percent of the leaf area covered by Septoria lesions. With susceptible varieties the percentage of leaf area covered was closely correlated with the amount of inoculum applied. The other host variety used as a check was Clintafe, which, with the dosage used, showed a leaf area coverage of about 30 percent. The scale used for leaf reading is reproduced in Figure 2[2]. An explanation of this scale accompanies the figure.

In the 1953 season no culm readings were obtained because very little culm infection occurred. Hot dry weather caused premature ripening of the oats and stopped development of the

[2]Photographs by Dr. J. A. Browning.

disease during the time when culm infection normally would have occurred. Approximately the same type of weather occurred in 1954 so that no culm readings were obtained in that year either. However, it was believed that a reliable measure of resistance could be obtained without stem lesion data. As stem infection is dependent upon inoculum formed in the leaf tissues, it might be expected that reactions of the leaves would provide a satisfactory estimate of reaction of the plant. Both Poole (7) and Lund (4) found that leaf and culm readings showed a high positive correlation.

Testing for Resistance

In 1953 two replications of the C.I. collection of oats were planted at Ames, Iowa, and inoculated as described above. Leaf spot readings were taken on the first replication according to the scale shown in Figure 2. In the second replication only those selections having a reaction of 20 percent or less in the first replication were read. From the 4751 entries in the C.I. collection, 293 were selected which had readings of 20 percent or less in both plantings. Three replications of the seed from these 293 selections were planted in 1954 at Ames, Iowa, and in addition two plantings of the entire C.I. collection were made at Kanawha, Iowa. The plants at both locations were inoculated as described previously. For the purpose of taking crown rust readings an additional planting of the C.I. collection was made at Ames, Iowa. These plots were in the same location as the 1953 plantings, and excellent natural Septoria leaf spot infection developed and was recorded.

Also in 1954, five selections that had shown very marked resistance in the 1953 tests were planted in two replications in rows alternating with rows of the susceptible variety Cherokee. The results of this test are shown in Figure 3.

In 1954 leaf spot readings were taken at Ames on the three replications of the material selected at Ames in 1953. At Kanawha in 1954 readings were taken on the entire first replication of the C.I. collection as well as on those selections in the second replication which had given a reading of 20 percent or less in the first.

As a result of testing the C.I. collection for two years several selections have been found to be significantly more resistant than any of the commercial varieties now distributed in the North Central area. Whether these will prove to be useful as breeding stock for resistance to S. avenae is yet to be determined. The selections chosen as a result of this testing are shown in Table 1. The values shown in Table 1 indicate the percentage of leaf area covered by Septoria lesions. For convenience only the first unit of the percentage is listed in the Table, so that a 5 in the table indicates 50 percent leaf area covered by Septoria lesions etc. An analysis of variance showed the differences between replications to be highly significant. None of the 24 selections exhibiting high resistance was significantly better than any of the others, but all were significantly superior to the relatively susceptible variety Cherokee.

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IOWA AGRICULTURAL EXPERIMENT STATION

KANSAS WHEAT MOSAIC SITUATION (1953-54)[1]

Webster H. Sill, Jr., Hurley Fellows, and Claude L. King

The two important virus diseases of wheat in Kansas again caused heavy losses in the 1953-54 season.

The soil-borne wheat mosaic was prevalent in hundreds of fields in most of the counties in the eastern third of the State. The most westerly counties where diseased fields were found were Reno, Sedgwick, Harvey, McPherson and Saline. The 1953-54 growing season was characterized by a long moderate fall, an "open" winter, and a long cool spring with adequate late rains. Usually in Kansas the symptoms of this disease largely disappear shortly after the onset of hot weather. This year, however, symptoms persisted in many cases nearly to maturity and losses were greater than usual. Losses from this disease averaged about 26 percent in the diseased spots checked in the 1953-54 season, as compared with average losses of 10 percent in diseased areas in 1951-52. The State loss for the 1953-54 season was estimated at $3,000,000, compared with $1,500,000 in 1951-52. The varieties Concho and Comanche are showing excellent resistance. Other very good resistant varieties can be expected soon.

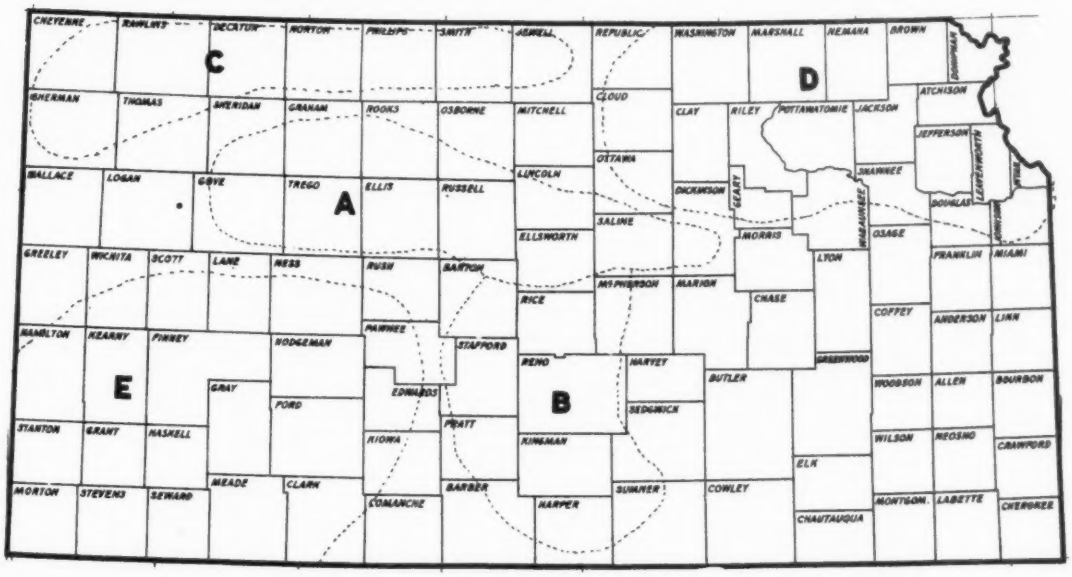

FIGURE 1. Approximate areas where wheat streak mosaic occurred in the 1954 crop. See text for information concerning areas.

Wheat streak-mosaic virus was the major disease of wheat in Kansas in 1954 and was a major factor, along with the early drought and extreme soil blowing, contributing to yield reduction. As indicated by a fall and winter survey (1953-54), this virus was extremely widespread in Kansas this season. Resurveys in the spring confirmed the winter survey. Most of the wheat fields in Kansas in the western two-thirds of the State had at least a trace to 1 percent of diseased plants. Diseased plants were also common in northeastern counties. Southeastern Kansas had very little streak mosaic.

The highest percentage of diseased plants and diseased fields occurred in a double tier of

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counties ranging from Dickinson County westward to Sheridan County mostly in the northern half of the State. (Fig. 1, area A). Most early-planted and early-emerging fields in these counties had a high percentage of diseased plants. Losses were severe in many of these fields and were considerable in most. However, the extremely cool weather during late April and May after the rains commenced was a most favorable environment for optimum wheat growth and was particularly unfavorable for optimum disease development. Hence, streak-mosaic losses in this area were minimized considerably, particularly in the more northwesterly counties. Late-sown and late-emerging fields usually had a low percentage of diseased plants and most were not damaged by the disease. The Kiowa variety, although only moderately tolerant of the disease so far, yielded surprisingly well.

The south-central area of the State had more badly diseased fields than any other area, but such fields were scattered and consisted chiefly of early-sown, early-emerging fields. Losses were heavy in rather large areas of five counties and portions of four others (Fig. 1, area B). Most late-sown fields in these counties were not damaged by the disease.

A third region with a smaller number of badly diseased fields included parts of nine northwestern counties (Fig. 1, area C). Most of the wheat in these counties was not hurt appreciably by streak mosaic.

In two areas of the State there were only scattered diseased fields and small diseased areas, most of the fields being healthy. Losses from streak mosaic in these two regions were light except in the few severely diseased fields. These two regions included all of the northeastern counties east of Highway 81, with the exception of areas in Dickinson and Saline Counties (Fig. 1, area D), and all of the southwestern counties west of Highway 183 and south of Highway 96 (Fig. 1, area E). The few badly diseased fields in this southwestern area were, for the most part, early irrigated fields.

With the help of county agents and other agricultural specialists the State loss caused by streak mosaic was estimated at $14,000,000, which makes the 1954 season second only to the severe 1949 outbreak when there was an estimated $30,000,000 loss.

DEPARTMENT OF BOTANY AND PLANT PATHOLOGY AND EXTENSION DIVISION, KANSAS STATE COLLEGE, AND FIELD CROPS RESEARCH BRANCH, AGRICULTURAL RESEARCH SERVICE, U. S. DEPARTMENT OF AGRICULTURE

METHODS FOR DETERMINING THE SUCCESS OF GRAFT UNIONS BETWEEN PLANTS IN STRAWBERRY VIRUS STUDIES

A. C. Goheen[1]

Presence or absence of virus in strawberry plants is determined by grafting the runner of the plant being tested with a runner of an indicator plant, usually Fragaria vesca (1, 2, 3, 4). Development of definite symptoms in the indicator plant within about 4 weeks after grafting proves the presence of a virus. Their failure to develop within 6 or 8 weeks indicates freedom from detectable viruses or lack of union between the runners. To be sure that a plant is actually free of virus, Demaree and Marcus (1) and Miller (4) suggested that a second graft be made and rechecked after a second period of indexing.

In routine indexing of plants to determine whether they are free of virus, a test to show if the union between the plant being tested and the indicator had been successful would be very helpful. This would often avoid the necessity of retesting. Therefore, the following test was developed at Beltsville. The usual runner inarch grafts of plants being tested and indicator plants were made as described by Demaree and Marcus (1) and the paired plants were allowed to grow on the bench for 6 to 8 weeks. About 4 days prior to the checking of the plants for virus transmission, the runner of the mother plant being tested was severed before the graft, the first daughter plant was severed from any daughter plants that developed subsequently, and the roots and some leaves were carefully removed from the first daughter plant. The runner between the mother plant and the first daughter plant of the F. vesca indicator was left undisturbed. If no wilting or death of the isolated daughter plant with roots removed occurred by the time the plants were examined, it was apparent that a union had been formed at the graft and that plants from which no virus had been transmitted (Fig. 1) were truly virus-free. Successful unions with runner grafts depend in part upon the skill of the person making the graft. In our tests successful unions have been obtained in 95 percent of the grafts.

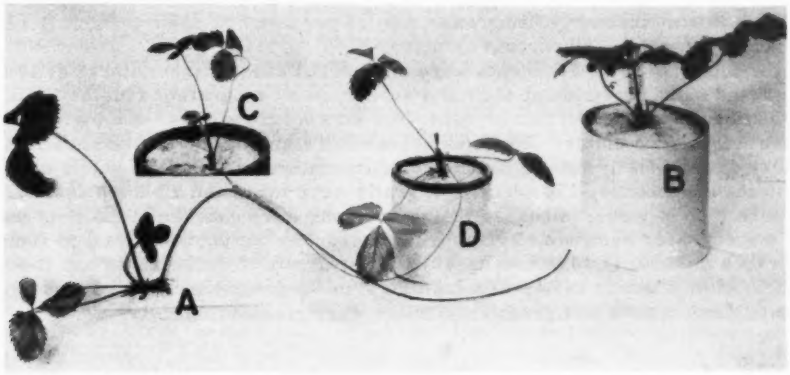

FIGURE 1. The first daughter plant, A, of a mother strawberry plant being tested, B, supported entirely through a graft to a Fragaria vesca plant, C. Thus, a successful graft union had been effected. First daughter plant of F. vesca, D, shows no virus symptoms, thus, indicates virus freedom of the plant B.

Many strawberry varieties do not produce runners readily in the greenhouse and at times a test for virus is desired before the plants have produced runners. In those cases a graft between a leaf petiole of the plant and a stolon of the indicator plant, as described by Harris and King (3), can be made. This type of graft can be tested for successful union with greater ease than the runner graft. About 4 days before the plants are examined for evidence of virus transmission, the petiole is severed from the plant being tested at a point below the graft. The runner of the indicator plant between the mother and first daughter plant is left undisturbed (Fig.

[1] Pathologist, Horticultural Crops Research Branch, Agricultural Research Service, U. S. Department of Agriculture.

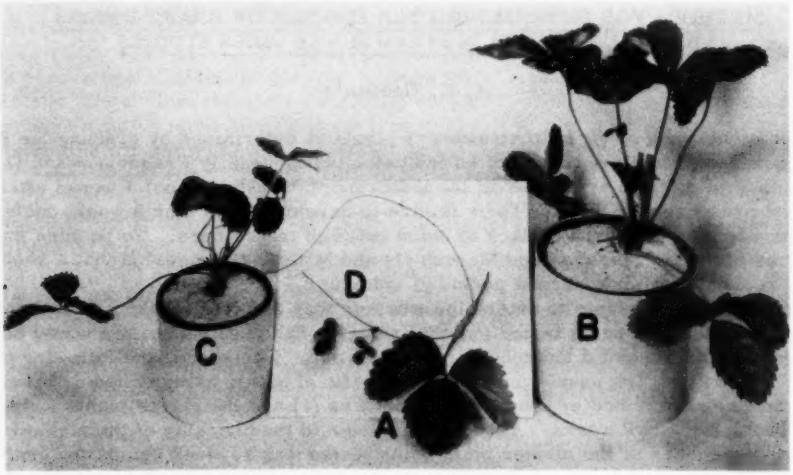

FIGURE 2. A severed leaf, A, of strawberry plant being tested, B, supported through a petiole graft to Fragaria vesca, C. Thus, a successful graft union between the tested and the indicator plant had been effected. The first daughter plant of F. vesca, D, shows no virus symptom and thus indicates virus freedom of plant B.

2). If union has occurred, the severed leaf will remain green and turgid, and if no virus symptoms are apparent in the indicator plant the plant can be classed as virus-free. In our tests in 1954, the success with this method of grafting was about 10 percent. In other tests at Beltsville by D. P. Ink, the success has been 50 percent or more.

During the winter of 1953-54, plants were obtained at random from stocks of 12 strawberry varieties from the increase fields of each of 4 nurserymen cooperating with the U. S. Department of Agriculture in the production of virus-free strawberry stocks. Each grower had 2 to 3 acres of these virus-free plants. Large samples were taken initially to be sure that at least 10 plants per acre were actually indexed from each cooperator. After these plants had become established in the greenhouse, 158 successful grafts were made and all the plants thus tested were found to be free of virus. Because the graft unions were checked at the time the indicator plants were inspected for evidence of virus transmission by the above-described runner- or petiole-severance method, it was unnecessary to regraft any of these plants and it was possible to discard them after 6 weeks rather than hold them in the greenhouse for a second indexing period. The savings in time and greenhouse space were considerable.

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HORTICULTURAL CROPS RESEARCH BRANCH, AGRICULTURAL RESEARCH SERVICE, U. S. DEPARTMENT OF AGRICULTURE

CHRYSANTHEMUM RINGSPOT VIRUS, A NEWLY RECOGNIZED PATHOGEN FOUND IN COMBINATION WITH CHRYSANTHEMUM STUNT VIRUS

Philip Brierley[1] and Floyd F. Smith[2]

Summary

A garden chrysanthemum from Alabama showing large yellowish ring patterns in the leaves was found infected with a previously undescribed chrysanthemum ringspot virus together with chrysanthemum stunt virus. This ringspot virus proved transmissible by grafting and with difficulty by sap inoculation to chrysanthemum but to no other plant tested. It was not transmitted by Myzus persicae. Efforts to free the ringspot virus from the stunt virus which accompanies it failed. The combination of ringspot with stunt is more damaging than stunt alone to the Good News variety of chrysanthemum.

In June 1953, Professor K. H. Garren sent from Auburn, Alabama, chrysanthemum leaves showing large yellowish chlorotic ring patterns (Fig. 1), symptoms not seen before by the writers. Cuttings of the affected plants supplied later were rooted and tested for the known viruses of chrysanthemum. Nine of ten cuttings developed the ring patterns; one did not; all 10 plants proved infected with chrysanthemum stunt virus. The source variety is a garden chrysanthemum of the Fuji class, similar to the variety Peggy Ann Hoover, but not identical with it. Professor Garren reported that the infected plants had been purchased from a nursery in Ohio.

Cuttings of the one source-plant free from ringspot were graft-infected and showed typical ringspot symptoms after 12 weeks. Scions affected with ringspot grafted on healthy test varieties of chrysanthemum produced predominantly stunt symptoms on two prompt reactors to stunt virus, Golden Mistletoe and Blazing Gold. The latter developed a few chlorotic rings 3 months after grafting; Golden Mistletoe deveoped no rings in 6 months. Of the slow or weak reactors to stunt, Friendly Rival expressed rings after 2 months, Peggy Ann Hoover after 2 months, and Mary MacArthur after 3 months. Good News, which reacts to stunt with transitory yellowish vein-banding after about 30 days, reacts most distinctively to ringspot. Yellow spots with slight constriction of adjacent tissues appeared in leaves after 6 weeks. Yellow blotches, rings, leaf dwarfing and distortion (Fig. 2) followed after 6 months, intensity of symptoms varying considerably in the five plants grafted. No flower symptoms other than those caused by stunt virus appeared in any of the chrysanthemum varieties graft-infected with stunt and ringspot viruses.

Mechanical inoculation by Yarwood's[3] fresh leaf method from the ringspot virus source to ten Good News chrysanthemums produced bright-yellow spotting in eight plants after 12 weeks; only two plants subsequently showed the more severe leaf dwarfing and distortion effects of ringspot virus. The ringspot virus is thus mechanically transmissible from chrysanthemum to chrysanthemum. Similar inoculation methods failed to infect any other plant tested: bean, China aster, cineraria, Datura stramonium, Gomphrena globosa, Nicotiana glutinosa, tobacco, petunia, Physalis angulata, snapdragon, or zinnia. Inoculated cinerarias were severely dwarfed and curled, but only stunt virus was reisolated in chrysanthemum. The ringspot virus apparently has a narrower host range than the stunt virus.

Since stunt virus is not aphid-borne it was thought that possibly aphids might separate the ringspot virus from combination with the stunt virus. Myzus persicae, the only species tested, failed to transmit any virus from the complex.

Some of the mosaic viruses can be separated from combination with stunt virus by taking scions from test chrysanthemums a few weeks after these test plants are grafted with scions infected with both viruses. This procedure was tested as a possible means of freeing ringspot from stunt virus. Scions of the ringspot virus source variety were grafted on healthy Mary MacArthur plants. After 1 month, young laterals of these stock plants were used as scions on healthy Golden Mistletoe. Six of ten Golden Mistletoe plants developed stunt symptoms and were

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[1] Pathologist, Horticultural Crops Research Branch, Agricultural Research Service, United States Department of Agriculture, Beltsville, Maryland.

[2] Entomologist, Entomology Research Branch, Agricultural Research Service, United States Department of Agriculture, Beltsville, Maryland.

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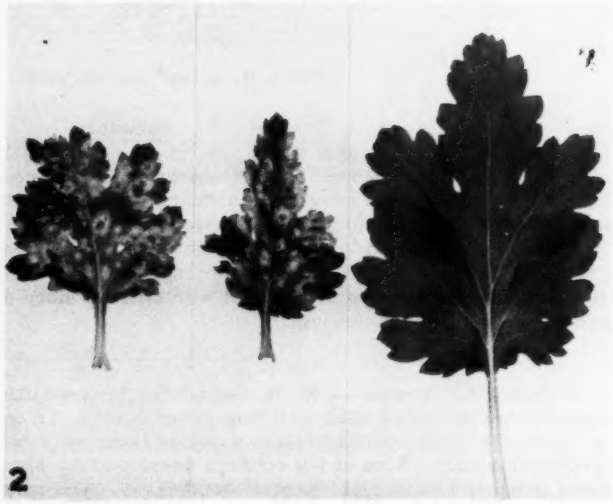

FIGURE 1. Ringspot symptoms, natural infection, in leaf of the source chrysanthemum variety (Fuji class). FIGURE 2. Ringspot symptoms in leaves of Good News chrysanthemum (left), photographed 6 months after graft inoculation. Healthy leaf (right).

discarded. The other four expressed no symptoms of ringspot and failed to produce rings on grafting to ringspot-free plants of the source variety. Apparently the ringspot virus moves more slowly through chrysanthemum tissues than does the stunt virus.

Since the ringspot virus, as far as known, is rare, significantly damaging to the Good News variety only, and not readily separable from the accompanying stunt virus, no further study seems justifiable at present. It would be of interest to know whether the ringspot virus occurs elsewhere and whether it can produce symptoms in chrysanthemum in the absence of the stunt virus.

HORTICULTURAL CROPS RESEARCH BRANCH, AND ENTOMOLOGY RESEARCH BRANCH, AGRICULTURAL RESEARCH SERVICE, UNITED STATES DEPARTMENT OF AGRICULTURE, BELTSVILLE, MARYLAND

APHID TRANSMISSION OF TOBACCO RINGSPOT VIRUS IN GLADIOLUS

Floyd F. Smith and Philip Brierley[1]

The tobacco ringspot virus is common in gladiolus, associated with stunt (4), white break (4), and corm ringspot (5), but with no known causal relation to most of them. It is perhaps most frequently associated with white, yellow, or brown flecking and streaking in gladiolus leaves. Some symptoms of this type appear to be caused by tobacco ringspot virus and others by cucumber mosaic virus. As early as 1944 symptoms of brown and white streaking were duplicated by aphid transmission from gladiolus to gladiolus seedlings, but the causal virus was not identified at that time.

After Berkeley (1) and Bridgmon and Walker (2) detected tobacco ringspot virus in gladiolus in 1951, we rechecked our stock of previously inoculated gladiolus for this virus (3). It was found in one group of gladiolus seedlings that had been exposed in January 1950 to green peach aphids (Myzus persicae (Sulz.)) transferred from naturally infected white-streaked gladiolus. Nine of 13 plants exposed developed white streaking comparable to that expressed by the source plant. In four separate index trials, tobacco ringspot virus was recovered from these seedlings each time, twice in company with bean yellow mosaic virus and twice alone.

In April 1954 another transmission trial was made by transferring green peach aphids from the infected gladiolus seedlings mentioned previously to ten healthy gladiolus seedlings. One of these plants expressed white streaking in leaves; this plant yielded only tobacco ringspot virus on indexing.

The two cultures of tobacco ringspot virus isolated from these two tests are somewhat less virulent to tobacco than the type strain American Type Culture Collection No. 98 supplied by H. H. McKinney, but they fully protect tobacco against superinfection by this type strain. The test seedlings used in both insect-transmission trials are from a single seedling clon, produced from a single seed and propagated in greenhouse culture only. No virus contamination has been detected in this clon, and index tests of unexposed plants of the clon have been consistently negative.

Since no alternative explanation is available for the presence of the tobacco ringspot virus in these two groups of seedling gladiolus, the green peach aphids must have transmitted the virus. It is not certain that the presence of a mosaic virus in combination is required for aphid transmission of tobacco ringspot virus, as McWhorter (6) suggests for "western ring spot virus" in leguminous plants. The hypothesis that aphids transmit ringspot viruses only in company with mosaic viruses is tenable but difficult to confirm in gladiolus. Viruses of the bean yellow mosaic group are prevalent in gladiolus (4). They are perhaps more difficult to detect than the tobacco ringspot virus by the usual index methods. Furthermore, a virulent tobacco ringspot virus produces severe necrotic effects in the bean varieties commonly used to detect the bean virus. When both viruses are present in the same plant, expression of the bean virus is precluded in some index tests.

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ENTOMOLOGY RESEARCH BRANCH, AND HORTICULTURAL CROPS RESEARCH BRANCH, AGRICULTURAL RESEARCH SERVICE, U. S. DEPARTMENT OF AGRICULTURE

[1] Respectively, entomologist, Entomology Research Branch, and pathologist, Horticultural Crops Research Branch, Agricultural Research Service, United States Department of Agriculture, Beltsville, Maryland.

VARIETAL SUSCEPTIBILITY OF CELERY TO ASTER YELLOWS

M. Yamaguchi and J. E. Welch

Aster yellows of celery, caused by the aster yellows virus, reached epiphytotic proportions in commercial fields of the Utah 10-B variety at Brentwood, California, during the fall of 1952. An experiment to study the effects of fertilization on the prevalence of brown checking, or adaxial cracked stem, provided information on the occurrence of the aster yellows disease in several varieties.

A split-plot experiment having four fertilizer treatments for the main plots and four varieties, Utah 10-B, Utah 52-70, Utah 16, and Summer Pascal, for the subplots was transplanted near the middle of a large commercial field of Utah 10-B at Brentwood on July 15, 1952. The plants were grown in the greenhouse at Davis but were subsequently moved to a lath-house at Davis for a few weeks prior to transplanting in the field. Each subplot contained 100 plants and the fertilizer treatments were replicated twice. Aster yellows counts were made on November 5, 1952, which was about three weeks prior to market maturity. Within each variety the percentage of aster yellows in the various fertilizer treatments was not significantly different, so the aster yellows counts for all fertilizer treatments were combined for each variety.

Variety	Number of plants examined	Percent aster yellows
Utah 52-70	678	32.5
Summer Pascal	695	39.5
Utah 10-B	702	49.8
Utah 16	687	54.0

L. S. D. 5% level = 13.3 percent

The table shows that Utah 52-70 had a significantly lower percentage of aster yellows at the 5% level than Utah 10-B and Utah 16; Summer Pascal also had a lower incidence of the disease than Utah 16. No differences were significant at the 1% level (L. S. D. = 24.5 percent), and only the above comparisons were significantly different at the 5% level.

These results do not necessarily indicate that some of the varieties tested are more resistant to the aster yellows disease of celery than the others. The data may be an index that the leafhopper vectors show varietal preferences in their feeding habits. Furthermore, from a commercial standpoint, if only a "resistant" variety were planted in a field, the incidence of the disease might be just as high as with a more "susceptible" variety.

DEPARTMENT OF VEGETABLE CROPS, UNIVERSITY OF CALIFORNIA, DAVIS, CALIFORNIA

ASSOCIATION OF INTERNAL BROWN SPOT OF POTATO TUBERS WITH HOT, DRY WEATHER

B. A. Friedman[1]

Summary

Considerable internal brown spot occurred in New York- and New Jersey-grown potato tubers in the 3 years from 1948 to 1953 when hot dry weather resulted in drought conditions. The disorder did not occur to any appreciable extent during a hot, wet season or in two seasons when drought conditions were not observed. The symptoms of internal brown spot are described and its probable synonymy is given. The symptoms of internal brown spot and heat and drought necrosis of potato tubers differ in several respects but whether or not these two disorders are the same is not certain. The non-occurrence of corky ring spot in New York- and New Jersey-grown potatoes and the absence of external and internal ring-like symptoms in tubers affected with internal brown spot are considered evidence that they are different diseases.

During the period from 1948 to 1953, potato tubers from New York (Nassau and Suffolk Counties) and New Jersey (Mercer and Monmouth Counties) affected with internal brown spot were seen in considerable numbers in some years, but in other years little internal brown spot was observed. As the occurrence of internal brown spot has been reported to be associated with high temperatures, it was a matter of some interest to determine why this disease did not occur to any appreciable extent in 1952 when high temperatures prevailed. A study of the relationship of temperature and rainfall and internal brown spot was undertaken, using the records of the New York City weather station since that location is approximately midway between these two potato-producing areas.

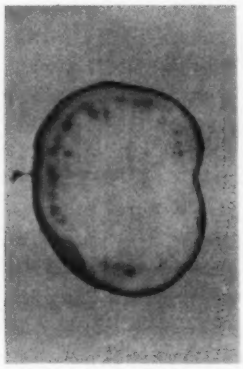

FIGURE 1. Internal brown spot lesions in central parenchyma of potato tuber. FIGURE 2. Internal brown spot lesions in region of vascular ring. FIGURE 3. External view of russeted tuber (below) which showed internal brown spot when cut; healthy, smooth-skinned tuber above.

Symptoms of Internal Brown Spot

Affected tubers show no external symptoms, and the characteristic light yellowish-brown to dark rusty-brown spots are found only after they are cut. The discolored and necrotic tissues are firm, granular, or corky in texture and are irregularly shaped and indefinite in outline. The spots vary from minute specks to blotches 3/4 inch or more in extent, but usually they range from 1/4 to 1/2 inch in diameter. The spots are scattered irregularly in the central parenchyma

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[1] Plant Pathologist, Biological Sciences Branch, Agricultural Marketing Service, U. S. Department of Agriculture.

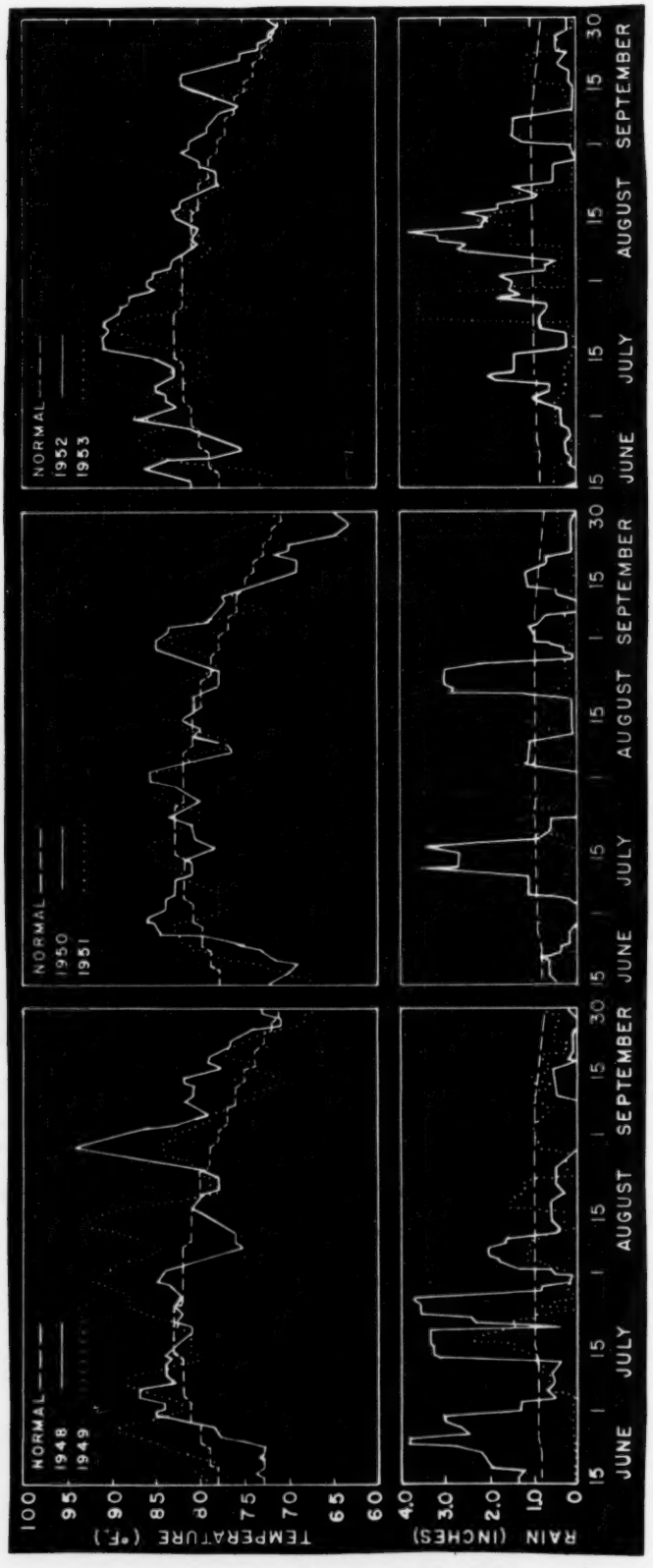

FIGURE 4. Temperature and rainfall conditions from 1948 to 1953. Seven-day moving average of the daily maximum temperature, above, seven-day moving total rainfall, below.

tissue but are often found in the region of the vascular ring and occasionally in the cortical tissue between the vascular ring and the surface of the tuber.

In cross-section, the lesions occasionally are distributed in an irregular radial pattern extending from the region of the vascular ring inward toward the center of the tubers (Figs. 1 and 2). Most of the lesions are found near the bud (eye) end of the tubers and they seldom occur much beyond the middle. Affected tissues have not been found at the stem end. Internal brown spot is most intense and occurs most commonly in large, long, and irregular-shaped tubers. It is often associated with abnormal russeting of the skin (Fig. 3). It has not been observed in tubers showing greening. The vines and foliage of plants which produce affected tubers have a normal appearance.

Maximum Temperatures and Rainfall, 1948 to 1953

The upper part of Figure 4 shows the daily maximum temperature recorded at the New York City weather station from June 15 to September 30 for 1948 to 1953, while the lower part shows the rainfall data. For comparison, the normal (average) daily maximum temperature and rainfall curves for the 30-year period from 1921 to 1950 are also given. In order to make a smoother curve (see reference 13), each point on the temperature curves represents the average of the daily maximum temperatures of the 7-day period on the date indicated while the points on the rainfall curves represent the total rainfall for the corresponding 7-day periods.

In 1948 the average daily maximum temperature was higher than normal continuously from August 26 to September 26, and much higher from August 26 to September 3 during which time it was above 90° F. for 5 days. From the start of the heat wave, rainfall was much below normal and only 1.13 inches fell from August 26 to September 30, of this 0.54 inch fell on September 30. In 1949, the average daily maximum temperature was above normal during three periods of the growing season, but especially during a prolonged heat wave from July 22 to August 16, during which the average daily maximum was 90° or above for 10 days. At the same time only 1.67 inches of rain fell, whereas the normal for the period is 3.22 inches. During 1950, the daily maximum average never reached 90° and was over 85° for only 5 days. Rainfall was about normal from June 15 to September 30, as 12.20 inches rain fell as compared with 14.27 inches for the 30-year average.

In 1951, temperature reached a maximum average of 86° F. for only 2 days during the growing season. At the same time rainfall was well below normal, ranging from 8.49 inches to 14.27 inches from June 15 to September 30. During 1952, a heat wave occurred from July 14 to August 3, during which the average daily maximum was 90° or above for 9 successive days. From the start of the heat wave on July 14 to August 15, a total of 6.87 inches rain fell, whereas the normal rainfall for that period is 4.34 inches. In 1953, a record-breaking heat wave occurred from August 27 to September 8, with an average daily maximum of 90° or over for 9 successive days. From August 27 to September 30 only 1.61 inches rain fell, whereas the normal is 4.09 inches.

Relation of Internal Brown Spot to Temperature and Rainfall

In New York and New Jersey, internal brown spot occurred to a considerable extent during 1948, 1949, and 1953, but it was seldom found or not observed in 1950, 1951, and 1952. Temperatures well above normal prevailed during 4 years (1948, 1949, 1952, and 1953), while rainfall was below normal in 1948, part of 1949, 1951, and 1953.

In 1948 and 1953 the heat waves, which occurred late in the season, were accompanied and followed by only a little rainfall. Drought conditions resulted and internal brown spot appeared in potato tubers. The heat wave of 1953 was more severe than that of 1948. In 1953, internal brown spot was found to be more extensively distributed than in 1948, but the tubers were much less severely affected. While a number of conditions might have been involved, it is believed that the principal reason for this difference was the great reduction in acreage of the susceptible Green Mountain variety and the large increase in plantings of the more resistant Katahdin between 1948 and 1953. In 1949, the prolonged heat wave from July 22 to August 16 consisted essentially of two shorter periods, the first of which reached its peak on July 30 and the second on August 11. During the first peak very little rain fell, and it is believed that during this hot, dry period susceptible tubers were affected. The second peak of hot weather was followed immediately by considerable rainfall, and, as previously reported (24), second growth, jelly-end, and jelly-end rot of tubers developed.

During the growing season of 1950, the weather was neither hot nor dry and internal brown spot was of very slight importance. The amount of rainfall was below normal in 1951, but there was no heat wave, drought conditions were not reported, and internal brown spot was not observed in tubers in a number of sample lots. In 1952, the intense heat wave of July 16 to August 3 was followed immediately by abundant rainfall. Internal brown spot did not occur to any appreciable extent in 1952, but considerable jelly-end and jelly-end rot developed (24).

Discussion

Synonymy: Internal discolorations and necroses of potato tubers may be caused by a number of different conditions. Internal brown spot (12, 14, 16, 25, 48), however, seems to be identical with internal brown rot (26), interior spotting (11), brown fleck (28, 73), internal browning (70), Eisenfleckigkeit (21), Buntwerden (21), Buntfleckigheit (21), internal disease (71), Buntheit (69), blotch (32), internal rust spot (52), Stippigkeit (47), Stockfleckigkeit (6), maculatura (screziatura) ferruginosa (53), and physiological internal necrosis (37).

Resemblance to Other Diseases: Several other internal disorders of potato tubers resemble internal brown spot but differ from it in one or more respects. These include internal brown fleck which occurs in potatoes grown in acid, phosphorus-deficient soils, especially under drought conditions (15, 55); internal brown streak (60); and internal rust spot (canker type) in which affected tubers develop spots and cavities in storage (8, 77). In contrast tubers affected with internal brown spot do not develop cavities and the incidence and severity of the disease do not change during storage (21, 23, 31, 37, 41, 77, 78).

Comparison with Heat and Drought Necrosis: While the symptoms of internal brown spot and of heat and drought necrosis (also called drought spot, or heat necrosis) are very similar their relation is uncertain and the two disorders have been described separately (16, 18, 66, 77). Heat and drought necrosis differs in several minor respects from internal brown spot in that the former affects principally the vascular ring tissue. The browning occurs at the stem end as well as at the bud end of tubers, the discoloration is in strands rather than solid dark masses of tissue, and the dark spots may lie so near the surface as to give a darkened appearance to the skin (49, 66, 76). In California heat necrosis was reported as absent where a heavy top growth occurred in response to nitrogenous manures and it was postulated that the shading of the soil, with resultant lower soil temperature, might be more important in controlling the trouble than moisture relations (34). This is in contrast to the conditions found in New York where internal brown spot was more severe in tubers from plants with green foliage than in those with dead foliage (20, 22).

Comparison with Corky Ring Spot: Specimens of potato tubers with symptoms identical with those of corky ring spot have been received from Florida and Washington several times at this laboratory (17, 57). Kringerigheid and sprain, which are considered synonymous (6, 27, 56), bear a marked resemblance to corky ring spot. Symptoms of these disorders and internal brown spot have been reported at times to intergrade or occur in the same tubers (46, 63). In addition, in a number of cases the names corky ring spot and internal brown spot have been used synonymously or not clearly distinguished. In the present study, however, external or internal lesions in the form of arcs, loops, or rings characteristic of corky ring spot have not been observed in any of the lots of tubers affected with internal brown spot. Further, there are apparently no reports of the occurrence of corky ring spot in New Jersey or New York (75), and this disease has been considered distinct from internal brown spot (3, 6, 27, 31, 41, 44, 74, 75, 77).

Relation to Weather Conditions: The association of internal brown spot with weather conditions has been reported (19, 21, 32, 54). More specifically, occurrence of this disorder has been associated with hot, dry weather (20, 22, 37, 40, 57), drought (4, 14, 18, 35, 66), hot weather (30, 45, 78), or the alternation of drought with rainfall (63). Internal brown spot has been reported to occur during wet seasons (44), but it had been noted previously that under such conditions internal brown spot did not occur often (21). Internal brown spot did not occur in Hawaii, where a uniform temperature generally prevailed (10), or when weather conditions were equable (19). A long series of annual observations of the incidence and severity of internal brown spot for correlation with meteorological conditions would be desirable. In the absence of such records it may be inferred from our data for a six-year period that drought may play a more important role than high temperature alone inasmuch as internal brown spot occurred dur-

ing the hot, dry weather of 1948, 1949 and 1953, but not during the hot, wet weather of 1952 or in 1950 and 1951, when drought conditions were absent during the growing seasons.

Relation to Soil Conditions: Internal brown spot is reported also to be related to soil conditions (7, 21, 32, 48, 69, 73), to be worse in dry soils (4, 5, 18, 35, 42, 51, 66) and in light, sandy, gravelly, or stony soils (5, 16, 19, 27, 37, 41, 48, 54, 65), while it is absent or occurs to a slight extent in heavy or wet soils (19, 35, 41, 44). In some cases, however, it has been reported in wet or heavy soils (1, 72). The role that soil conditions play in the occurrence of internal brown spot has been shown in reports that in heavy soils potatoes remained healthy even when internal brown spot-affected tubers were used and the weather was conducive to the development of internal brown spot (19). It has also been reported that affected seed tubers yielded affected tubers in sandy soils but healthy tubers in muck soils (37), and that affected seed tubers yielded healthy tubers on suitable soils whereas normal tubers yielded affected tubers on unsuitable soils (44, 50). In addition, potatoes, except the extremely susceptible Ontario variety, did not show internal brown spot when planted on muck (38).

Physiological Nature of Internal Brown Spot: Internal brown spot is considered to be a physiological disorder because pathogenic bacteria and fungi have not been isolated from affected tissue (4, 11, 14, 21, 41, 44, 48, 70, 73); and the failure to transmit the disease by means of diseased seed (4, 7, 14, 21, 25, 42, 44, 48, 77, 78) or by grafting (27) has been considered to rule out a virus as an etiologic agent. That the disorder may arise from a disturbed water balance in the tubers (4) is shown by the occurrence of internal brown spot under drought conditions on light sandy soils during hot, dry weather. In support of this theory are the observations that under some conditions mulches which conserve soil moisture (37) and irrigation (20) may reduce the amount of internal brown spot; it should be noted, however, that either may also lower soil temperatures (30, 37, 39, 43, 76).

It is also known that under dry conditions (49) or high temperatures (43, 67) tubers tend to become irregular or elongated and have roughened skins; the association of internal brown spot with long tubers having russeted skins has been noted before. The fact that internal brown spot occurs under conditions of drought does not necessarily mean the disease is caused by a disturbed water balance per se, as it is known that under dry conditions plants may exhibit nutritional deficiencies caused by the unavailability of soil elements (61).

In this regard it has been reported that internal brown spot may be caused or influenced by nutritional deficiencies or disturbances of one type or another (4, 7, 9, 27, 29, 48, 63, 68). In addition, calcium and magnesium deficiencies of tubers were observed in the absence of foliage symptoms (59, 64), and on phosphorus-deficient soils potatoes showed internal rusty-brown lesions without external symptoms (33). Some workers, however, have found little or no difference in the occurrence of internal brown spot following various types of fertilizer treatments (36, 37, 44, 58).

While it has been reported that internal brown spot was not related to an oxygen deficiency (44, 58), the occurrence of this disorder on incrusted soils (1, 47), in wet soils (62), and in waterlogged parts of the field (41) suggests that this disorder may be due to respiratory disturbances. Under conditions of hot, dry weather it was believed that internal brown spot might result from respiratory disturbances as a consequence of water imbalance (37) and might be a form of blackheart that developed in sandy soils where high temperatures prevailed (74).

It has been stated that under adverse conditions water or nutrients may be withdrawn from tubers (49, 76), and conditions that resulted in excessive transpiration were believed to be the cause of internal browning of tubers (2). In this connection it has been observed that internal brown spot is worse in tubers harvested from plants with green vines (20, 22), and presumably this might be the result of the ability of the living vines and foliage to function in the withdrawal of material from tubers during a drought.

The occurrence of internal brown spot has been associated with a number of different conditions, but there are apparently no reports that this disorder has been reproduced under experimentally controlled conditions. Furthermore, the occurrence of internal brown spot in widely separated parts of the world under different growing conditions suggests the possibility that symptoms of internal brown spot may be induced by different conditions.

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BIOLOGICAL SCIENCES BRANCH, AGRICULTURAL RESEARCH SERVICE, U. S. DEPARTMENT OF AGRICULTURE

COLLETOTRICHUM ROOT ROT OF GREENHOUSE TOMATOES

Blair H. MacNeill[1]

Introduction

During the last ten years the sporadic appearance of a root rot of greenhouse tomatoes has been noted in southern Ontario. As early as 1946 a grower in the Burlington-Aldershot area reported a 60 percent loss in crop, while somewhat smaller losses were reported by growers in 1950 and 1951. In the 1953 spring crop, five growers in this same general area reported heavy losses, and an inspection of their houses revealed that 15 to 90 percent of the plants were diseased. In all cases a fungus identified as Colletotrichum atramentarium (Berk. & Br.) Taubenh. was isolated from the diseased roots.

The Disease

A superficial observation of the disease in the greenhouse suggests attack by Fuarium or Verticillium since the plants wilt and may even show some vascular discolouration when the stem is cut. This wilted condition cannot be corrected by heavy watering, and the plants when removed from the soil are found to be nearly devoid of roots. Plants which have been attacked as seedlings in flats seldom attain a height of more than 3 feet after transplanting into infested greenhouse soil; older plants which have survived through the season are thin and spindly, and flower clusters above the third or fourth fail to set fruit.

An examination of the roots of diseased plants reveals that the cortex of the main supporting roots is cracked and loose upon the stele, while the younger roots are brown and much shortened and distorted. Such plants are easily pulled from the soil owing to their poor root system. Sclerotia of the causal organism may be found on portions of the injured cortex and even upon the stem at soil level.

The Causal Agent

Diseased roots when thoroughly washed in running water and incubated in a moist chamber at room temperature will yield sporulating acervuli usually within 48 hours; accordingly, it is not difficult to obtain a culture of the organism by direct transfer from the spore ooze. On the other hand, when isolating from infections on the fine rootlets of seedlings the most satisfactory technique is to surface sterilize the tissue and plate it on acidified potato dextrose agar; acervuli are produced within 4 days. In all respects the fungus so obtained agrees with the description of Colletotrichum atramentarium (Berk. & Br.) Taubenh., an organism reported by Bewley[2] in 1921 to be highly destructive to tomatoes in Great Britain.

Infection experiments carried out in Wisconsin temperature tanks maintained at 16°, 18°, and 23° C. have indicated that the organism isolated as above is capable of attacking and destroying not only the roots of young tomato seedlings but the roots of plants 8 weeks and 12 weeks old as well. In these studies cornmeal-sand inoculum of C. atramentarium was added to (a) sterilized soil, and (b) non-sterilized soil which previously had been shown to be free of the root rotting organism.

With very young seedlings attack is swift, and necrosis of the rootlets, if it does not lead to the immediate death of the plant, results in a very unthrifty type of growth. In older plants attack is marked by the characteristic disintegration of the cortical tissue to reveal the stele. Severity of attack, especially upon older plants, may be regulated according to the concentration of the inoculum used. Preliminary experiments carried out in this regard suggest that the root rot observed in the Burlington-Aldershot area is an expression of a very high level of inoculum in the soil. This conclusion is further supported by the observation that the disease becomes increasingly intense with successive croppings in the same greenhouse soil.

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[1] Department of Botany, Ontario Agricultural College, Guelph, Ontario, Canada.

[2] Bewley, W. F. Seventh Annual Report, Cheshunt Experimental Station, Herfordshire, pp. 33-41, 1921.

Control

Steaming of infested soil in cubic-foot lots in an autoclave maintained at zero pounds pressure for 4 hours completely eliminated C. atramentarium. Similarly, treatment of infested soil using Dowfume MC-2 (methyl bromide 97.5%, chloropicrin 2.0%) at the rate of 4 lbs. per 100 cu. ft. of soil eradicated the pathogen. In some instances control of the disease was effected by Dowfume MC-2 fumigation at rates as low as 2 lbs. per 100 cu. ft. of soil; however, the complete eradication of the pathogen was not attained at this low rate of treatment as evidenced by the presence of some root rot lesions on the test plants. Subsequent plantings of tomatoes in soil treated at the low levels of fumigant became severely diseased.

Control of Colletotrichum root rot in commercial greenhouses has proved successful when soil sterilization with steam has been carried out in a thorough manner from a well-laid tile system. Alternatively, a number of growers using Dowfume MC-2 have obtained excellent control of the disease. However, in those instances in which low levels of fumigant are employed (2 1/2 lbs. per 100 sq. ft. of soil surface) it would seem advisable to fumigate the soil before each tomato crop.

DEPARTMENT OF BOTANY, ONTARIO AGRICULTURAL COLLEGE, GUELPH, ONTARIO, CANADA

SCLEROTINIA WILT OF BEANS IN MEXICO[1]

William D. Yerkes, Jr.[2]

The Sclerotinia wilt disease, caused by Sclerotinia sclerotiorum (Lib.) D By., has been reported only twice before on beans in Mexico: in 1928 from Los Tuxtlas, Veracruz, and in 1929 from Acámbaro, Guanajuato. In late August of 1954, wilting of bean plants in seed increase plots was noted at the experimental farm of the Oficina de Estudios Especiales, S.A.G., located at Chapingo, Mexico. The field was not uniformly affected. Approximately 10 to 15 percent of the plants were wilted. The affected areas were roughly circular, with diameters from .5 to 2.5 meters. Nine varieties in the same field were affected. A variety not affected was a short season (90 days) bush type called "Canario."

When first noted, the wilted plants had brown water-soaked lesions on the stems, extending from the soil level to 15 cm. above the soil level. Later the affected parts became covered with the characteristic mycelium of the fungus, and sclerotia were formed within the stem tissues as well as on the outside of the stems. The sclerotia formed within were in the shape of elongated cylinders that ranged in length from .3 to 1.5 cm. and were almost uniformly 2 mm. in diameter. Those produced in the exterior mycelial mat were irregularly spherical up to 5 mm. in diameter.

The rainfall during the 1954 growing season was much more abundant than usual, resulting in such rank growth of the bean plants that the rows were completely covered over. The soil beneath the plants was thus very moist all year, especially under the semi-vining varieties. The bush types were free of the diseases, probably because of the drier conditions under the plants.

The field in which the disease appeared has had a rotation of beans, wheat, sweet clover, corn, beans, etc., for two complete cycles. In the previous bean plantings (1951-52), no Sclerotinia wilt was noted.

The disease has been noted also this year in increase plots of soybeans and in the bean breeding plots. These three fields are no closer than 500 meters to one another. They have been under similar rotations for at least two cycles. A search for the disease in the surrounding areas has been unfruitful. This may be due principally to the fact that a much higher rate of planting is used on the experimental farm of the Oficina de Estudios Especiales than is normally used by the growers in the area. This higher rate probably encourages humid conditions beneath the bean plants.

It appears likely that the causal organism, Sclerotinia sclerotiorum, is present in many Mexican soils, but that it has not been reported more often because of conditions unfavorable to the development of the fungus and because of lack of observation.

MEXICAN AGRICULTURAL PROGRAM OF THE ROCKEFELLER FOUNDATION AND OFFICE OF SPECIAL STUDIES OF THE MEXICAN MINISTRY OF AGRICULTURE AND ANIMAL INDUSTRY

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[1] Journal Series Paper No. 19 of the Mexican Agricultural Program of The Rockefeller Foundation.

[2] Assistant Plant Pathologist with the Mexican Agricultural Program of The Rockefeller Foundation.

A VERSATILE SPRAY RIG FOR SMALL FIELD PLOTS

R. S. Cox, D. S. Harrison, and C. S. Yager[1]

Frequently a serious limitation to field evaluation of pesticides is the spray equipment available. Particularly among the shortcomings of most equipment are (i) lack of maneuverability, (ii) lack of versatility, and (iii) difficulty of cleaning the spray tank. A spray rig assembled in the machine shop of the Everglades Experiment Station, and in operation during the past season, has largely overcome these obstacles[2].

Description

The front and rear wheels and the axles were obtained from a "Bolens" garden tractor. Power to the machine and pump is supplied by a "Briggs and Stratton" Model "K" four-cycle air-cooled gasoline engine with a 3 h.p. rating (Fig. 1). One and one-half to 2 h.p. are required for the pump, and the remainder is used for propelling the spray machine. The pump is a "John Bean No. 64 Junior Duplex" with a 4 g.p.m. capacity and a pressure range of 0-400 pounds. It weighs approximately 60 pounds.

A 1942 "Studebaker" automobile transmission, including transfer and differential, was used for transfer of power to the drive sprockets. The steering mechanism and the gear shift were obtained from the same source.

The motor, pump, and drive (Figs. 1 and 4) of the machine were constructed and assembled as follows: a bearing plate was added to the transmission bell housing to carry the flywheel on a short, flanged shaft, thus retaining the original clutch. The motor was coupled directly to this shaft through a flexible coupling. Power moves through the clutch, transmission, universal joints, differential, and a roller chain final drive to the rear wheels.

The pump drive is transmitted from the flywheel shaft through a roller chain to a jack shaft, thence through the clutch, taken from a "Toro" power mower, to the pump via a final chain drive. All chains used were size number 50. The reduction to the jack shaft was approximately 2 to 1; the final reduction was computed to give 3.5 g.p.m. at full engine throttle (2300 rpm).

The specifications of the assembled machine are as follows:

Overall length	76 inches
Approximate weight	500 pounds
Tread width	42 inches[3]
Ground clearance	30 inches
Speed (Max.): 1st Gear	2.4 m.p.h.
2nd Gear	3.9 m.p.h.
3rd Gear	5.9 m.p.h.
Turning radius	12 feet

Two single-row booms are used on the machine: one is mounted underneath the frame (Fig. 2), and the other as a side delivery or outrigger boom (Fig. 3). The underslung boom has a maximum ground clearance of 30 inches. The drops on each side can be spaced 30, 36, or 42 inches apart. The out-rigger boom is readily installed on permanent braces fastened to the frame (Fig. 4). It has a 72-inch ground clearance, and can be mounted on either side of the machine.

Ten-gallon stainless-steel milk cans set in frames, one on each side of the driver's seat (Figs. 2 and 3), serve as tanks. Fungicides are suspended by means of by-pass agitation[4]. A small cylinder is mounted in front of the left-hand tank (Figs. 2 and 3). Water in the cylinder

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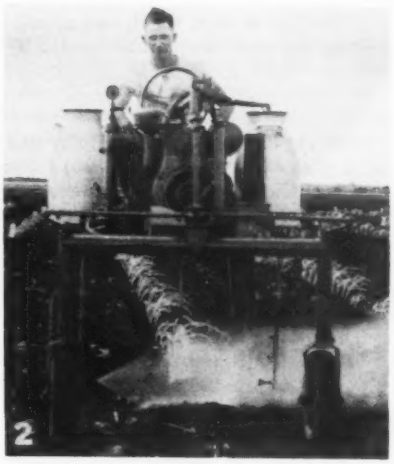
1 Associate Plant Pathologist, Assistant Agricultural Engineer, and Machinist, respectively.

2 The writers are indebted to G. R. Townsend for freedom to examine his spray rig (G. R. Townsend. 1952. Year-Around Field Trials Used in Screening of Fungicides. Agric. Chem. 7, No. 5: 77, 79, 135), from which many useful ideas were obtained.

3 The 42-inch tread was used to insure stability of the rig.

4 The suction line and the by-pass line are assembled as one unit (Fig. 4) to facilitate changing from tank to tank during operation.



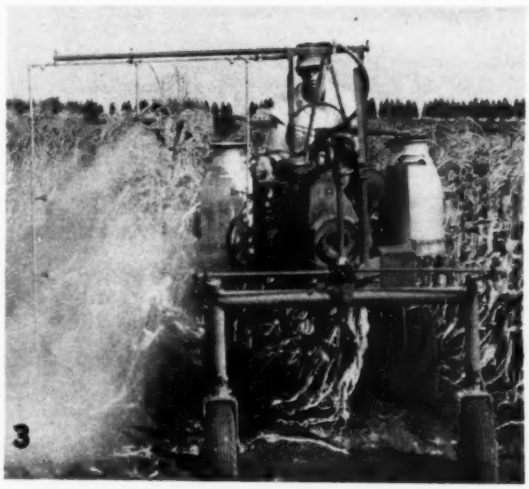


FIGURE 1. Rig mounted on low-clearance drop-center bed.
FIGURE 2. Rig in operation employing the low-clearance boom. Note cylinder in front of spray tank on right.
FIGURE 3. Rig in operation employing high-clearance boom.
FIGURE 4. Side view of rig showing centrally located assemblage.

is for the purpose of flushing the line between treatments.

All accessories are mounted toward the middle of the rig to insure maximum stability and balance (Fig. 4).

A trailer to haul the spray machine was constructed with a low-clearance drop-center bed on which the machine can be loaded by means of its own power (Fig. 1).

Use

The rig has been successfully used on sweet corn and pepper. It should be readily adaptable to almost any vegetable crop, even the procumbents such as cucumber.

Although one man can successfully handle an operation, two are more desirable for maximum efficiency. In our work the following routine is commonly followed:

One man (on the ground) mixes chemicals while the other operates the rig. A total of four spray tanks (milk cans) is used, two for the ground man and two on the rig (Figs. 2 and 3). Chemicals (treatments) are listed numerically, and the one with the lowest number always is placed in the tank on the left-hand side of the rig.

The test crop is divided into tiers separated by alleys of 12 to 25 feet, preferably the latter. Each tier consists of one replication of each treatment, i.e., the randomized block design. The plots are labeled so that the numbers are readily discernible from the driver's seat (Fig. 2).

After spraying all the replications of a given treatment, the operator passes the suction line-overflow assemblage (Fig. 4) through the flush can (Figs. 2 and 3), thence to the opposite spray tank. The pump is disengaged with the clutch between each operation.

Another trip is made through the plots to spray with the subsequent material. Thus, two treatments are applied in one round trip.

The two used tanks are replaced with the two freshly prepared by the ground man, and the operator is ready for another "round" of treatments.

The outfit has been used on a corn experiment in which 17 treatments (single 40-foot-row plots) were replicated 4 times (total of 68 plots); also, on a pepper experiment composed of 40 treatments replicated 4 times in single 50-foot-row plots (total of 160 plots). The time required to spray the corn was usually less than 45 minutes, and for the pepper slightly less than 2 hours. This is an average of approximately 80 plots per hour. First gear was used in both cases.

With known ground speed, pressure, and nozzle type, accurate information on dosage is easily obtained. The rig is also very satisfactory for studies on effect of nozzle type and placement on disease control.

EVERGLADES EXPERIMENT STATION, UNIVERSITY OF FLORIDA, BELLE GLADE, FLORIDA

LONG DISTANCE TRANSMISSION OF OAK WILT IN WISCONSIN[1]

L. H. McMullen, C. R. Drake, R. D. Shenefelt, and J. E. Kuntz[2]

Sap-feeding beetles (Nitidulidae) and fruit flies (Drosophila) have been shown experimentally to be capable of transmitting the oak-wilt fungus, Endoconidiophora fagacearum Bretz, to wounds in healthy oak trees (2, 3, 4, 5). In the experiments cited the Nitidulids were exposed to both perithecia and endoconidia, but transmission was reported only where perithecia were present.

During the 1954 season, tests were conducted to determine whether transmission by such insects occurs in Wisconsin, and to determine the role of endoconidia in transmission.

Insects collected from sporulating mycelial mats on wilt-killed trees or from banana baits were exposed overnight to the mats or to laboratory cultures of the fungus. In a few cases both endoconidia and perithecia were present on the mats. The insects were then transferred to glass containers and transported to selected trees. A T-shaped wound (2 inches x 2 inches) was made on the main trunk of each tree with a wood chisel and the bark was separated partially from the sapwood. The insects were transferred to plastic cages, 4 inches by 5 inches in size. In some cases mats or cultures of the fungus were placed in the cages along with the insects. The cages were fastened to the trunk over the wounds, the open side of each cage being sealed tightly to the tree with a plastic sealing compound. When the cages were removed 5 to 7 weeks later, the wounds were covered tightly with masking tape to prevent the entry of other insects. Trees with the wounds caged without insects served as checks.

The caging was started on May 1 and was continued at weekly intervals through September 3. Cages were attached and insects introduced on a total of 108 trees, not including checks. Fifteen of 52 trees wounded between May 1 and June 19 showed symptoms. Only two additional trees wounded after June 19 developed oak wilt. The fungus was isolated from all wilted trees. All 307 unwounded, uncaged trees and all of the checks remained healthy. In only one of the positive cases had the insects been exposed artificially to perithecia. Since perithecia were not observed in nature until May 28 it is unlikely that any insects had been in contact with ascospores prior to that time. Moreover, in four cases where transmission occurred, the insects were collected north of the known range of oak wilt, and were exposed only to mats or cultures without perithecia. Table 1 gives a summary of the positive tests.

Table 2 provides a list of insects which failed to transmit the fungus along with the inclusive dates of caging and the number of negative tests made with each. Negative results, in some cases at least, may be due to the fact that cages were not set out at the correct season.

In conjunction with the foregoing experiments, other trees were wounded without caging. Ten trees were wounded on April 22, ten different trees on April 29, and so forth at weekly intervals through September 3. In each series five trees were large (5.5 to 22 inches dbh) and five were small (2 to 4 inches dbh). Seven wounds were made on the main trunk of each tree. Six were hatchet cuts, three at the base and three at breast height. The seventh was a T-shaped wound located 4 to 6 feet above ground level and was similar to those made in the caging tests.

Oak wilt developed subsequently in ten of the large trees and in one of the smaller ones. The wilted trees had been wounded between May 15 and June 18. Within this period, the highest incidence of wilt occurred among those trees wounded on June 11 and on June 18. These results agree quite well with those obtained in Pennsylvania (1) except that the time is approximately one month later. The 207 unwounded trees in the test area all have remained healthy.

Many insects (Nitidulidae, Staphylinidae, and Drosophila) were collected from the wounds during the week following the wounding. The greatest numbers of insects occurred on wounds made during the first three weeks in June. Also, more insects were taken from the large trees than from the small ones.

In another area in connection with other experiments, a 3,000-yard right-of-way was

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[2] Respectively Research Assistant, Department of Entomology; Research Assistant, Department of Plant Pathology; Associate Professor, Department of Entomology; and Assistant Professor, Department of Plant Pathology, University of Wisconsin, Madison, Wisconsin. The authors are very grateful to Mr. Y. S. Sedman for his technical assistance during the progress of these experiments and to the U. S. National Museum for identification of the insects. The Nekoosa-Edwards Paper Company has also been generous in allowing use of this land and facilities.

Table 1. Experiments in which Endoconidiophora fagacearum was transmitted to wounded trees by insects exposed to the fungus, Wisconsin, 1954.

Tree no.	Species of insect	Source of inoculum	No. of insects per tree	Date caged	Date wilted
N2	Epuraea sp. (spp.)	Mat	4	May 1	July 16
N17	Cucujidae (unidentified)	Mat	20	15	2
N22	Glischrochilus fasciatus (Oliv.)	Mat	9	15	Aug. 8
N27	G. sanguinolentus (Oliv.)	Mat	6	22	Sept. 15
N29	Colopterus truncatus (Rand.)	Mat	25	22	July 16
N38	G. fasciatus	Culture	8	29	16
N40	Epuraea sp. (spp.)	Culture	15	29	22
N41	Epuraea sp. (spp.)	Mat[a, b]	15	29	16
N42	Lobiopa undulata (Say)	Culture	8	29	16
N55	Epuraea sp. (spp.)	Culture	12	June 5	16
N57	G. fasciatus	Culture[b]	8	5	22
N60	G. fasciatus	Culture[b]	3	12	Aug. 21
N61	G. quadrisignatus (Say)	Culture[b]	5	12	July 16
N65	Stelidota octomaculata (Say)	Culture	11	19	22
N66	S. octomaculata	Culture[b]	12	19	22
N76	G. fasciatus	Culture	4	July 9	Sept. 15
N113	Drosophila sp.	Mat[b]	100	Aug. 14	24

[a] Perithecia in inoculum.

[b] Inoculum caged with insects.

Table 2. Experiments in which Endoconidiophora fagacearum was not transmitted to wounded trees by insects exposed to the fungus, Wisconsin, 1954.

Species of insect	No. of negative tests	Inclusive dates of caging
Nitidulidae		
Colopterus truncatus (Rand.)	8	May 1 - May 29
Carpophilus sayi Parsons	2	Sept. 3
Epuraea sp. (spp.)	4	May 1 - Aug. 7
Stelidota octomaculata (Say)	14	June 5 - Aug. 28
Lobiopa undulata (Say)	7	May 15 - Aug. 7
Cychramus adustus Erichs.	1	June 30
Glischrochilus sanguinolentus (Oliv.)	2	May 15 - July 24
G. fasciatus (Oliv.)	25	May 1 - Sept. 3
G. quadrisignatus (Say)	21	May 1 - Sept. 3
Histeridae		
Platysoma sp.	1	June 12
Staphylinidae		
2 spp. unidentified	2	May 15 - May 22
Orthoperidae	2	May 15 - May 22
Drosophilidae		
Drosophila sp.	3	June 30 - July 16

brushed out through the woods to provide access for a mechanical root-breaker. Wounds on trees bordering the brushed right-of-way included blazes, sharp axe cuts, and gouges. The brushing was done between June 5 and June 15. By July 20, 26 trees had wilted along this right-of-way. All the trees that developed oak wilt had been wounded, the wounds extending into the sapwood.

In Wisconsin during recent years, cases of long-distance transmission of oak wilt have been relatively rare. Spread has been chiefly from tree to tree through root grafts. In contrast, the numerous cases of long distance transmission recorded in 1954 indicated that perhaps the conditions for such transmission are rather exacting. The results of the experiments described here indicated that Nitidulidae are capable of transmitting oak wilt by means of the endoconidia, and again stressed the critical nature of the time of transmission.

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UNIVERSITY OF WISCONSIN, MADISON

SPORES OF ENDOCONIDIOPHORA FAGACEARUM ON THE EXTERNAL SURFACES OF THE BODY OF NITIDULIDS

W. L. Yount, A. R. Jeffery, and H. E. Thompson

Summary

Endoconidiophora fagacearum, the oak-wilt fungus, was isolated from beetles of the family Nitidulidae. Epuraea spp. and Colopterus niger were the species found to be infested. Positive isolations were made in the spring and late fall when fresh mats were being formed.

A low percentage of free-flying insects, caught away from oak-wilt trees, yielded positive cultures of the fungus.

The fungus lived for more than 3 months on the bodies of insects kept in the refrigerator at 9° C.

The presence of viable conidia of Endoconidiophora fagacearum in the fecal material of certain insects found associated with the fungus mats on wilting oaks has been demonstrated. Bart and Griswold (1) first observed spores in the feces of the pomace fly, Drosophila melanogaster. Jewell (5), using a spermatization technique, proved the viability of spores in the fecal pellets of certain nitidulid beetles.

The present work, reporting results of cultures from washings of external surfaces of insects, was started early in 1953 in an attempt to find what species of insects and what portion of the insect population collected from wilt trees and from infested areas were carrying spores of the oak wilt fungus. Attempts to produce infections by caging insects taken from oak wilt mats or cultures of the fungus on wounds in healthy trees have usually resulted in low percentages of successful inoculation.

Norris (6) and Dorsey et al. (3) obtained a good percentage of infected trees from such inoculations. However, the experiences of other workers, Himelick et al. (4), Craighead et al. (2) and Thompson et al. (7) have indicated that certain very limiting factors hold the number of infections to a small proportion of the total number of trees caged. Temperature unfavorable to germination of the spores and continued growth of the fungus has been suggested by Himelick as one controlling factor. The proportion of the number of insects found associated with these wounds that would be carrying spore-loads also has a direct bearing on the probability of infection.

Procedure

To determine the insects that were carrying spores in oak-wilt areas, insects were collected from fresh mats, old mats, under the loose bark of trees killed by oak wilt, from the tops of freshly cut stumps, and from bran-yeast bait traps. The first insects were collected in November and December, 1953. In 1954, no insects were collected in January; but, starting February 10, insects were collected at bi-weekly intervals until June 11. During July and August, when very few mats are formed, no collections were made. On September 30 and again October 10, insects were again collected.

The insects were picked up with forceps or dissecting needles, and placed individually in gelatin capsules. Each group of insects was stored in a refrigerator at 9° C from the time it was brought in from the field until the insects were cultured. Each insect was shaken from its gelatin capsule into a sterile test tube containing 2 ml of distilled water. Several drops of this washing were placed in a sterile petri dish to which was added 1 drop of lactic acid. Melted Nutramigen agar (40° C) was poured over the plate. The cultures were placed in a 20° C incubation chamber.

Results

As is shown in Table 1, E. fagacearum was isolated from a few of the insects collected during the late fall period of mat production. During the winter the fungus could not be isolated from insects collected from old mats. In the spring, when new mats were being formed, the fungus was again isolated from insects collected both from mats and bait traps.

Of the many families of insects represented in this survey, the oak-wilt organism was isolated only from the Nitidulidae.

Table 1. Recovery of Endoconidiophora fagacearum in cultures from insects associated with infected oak trees; Pennsylvania, 1953-54.

Species	Source	Date collected	Number		Percentage positive
			Cultured	Positive	
Nitidulidae	Fresh mats	Nov. 3	35	1	2.9
Nitidulidae	" "	Dec. 21	20	2	10.0
Mixed Groups	Old mats	Feb. 10	19	0	0.0
Cucujidae	" "	Feb. 17	10	0	0.0
Nitidulidae	On and near old mats	Feb. 17	7	0	0.0
Staphylinidae	Under bark of oak-wilt tree	Feb. 17	10	0	0.0
Staphylinidae	Old mats	Feb. 19	80	0	0.0
Hymenoptera	" "	Feb. 19	10	0	0.0
Cucujidae	" "	Feb. 19	100	0	0.0
Nitidulidae	" "	Feb. 19	11	0	0.0
Rhyzophagidae	" "	Feb. 19	14	0	0.0
Nitidulidae	" "	Feb. 25	30	0	0.0
Staphylinidae	" "	Feb. 25	24	0	0.0
Cucujidae	" "	Feb. 25	2	0	0.0
Rhizophagidae	" "	Feb. 25	2	0	0.0
Staphylinidae	" "	Mar. 9	33	0	0.0
Scolytidae	" "	Mar. 9	3	0	0.0
Cucujidae	" "	Mar. 9	1	0	0.0
Nitidulidae	" "	Mar. 9	10	0	0.0
Rhizophagidae	" "	Mar. 9	2	0	0.0
Nitidulidae *	Traps baited with sawdust and yeast	Apr. 6	120	2	1.7
Nitidulidae	Fresh mats	Apr. 6	130	37	28.5
Nitidulidae	Mature mats	Apr. 27	98	6	6.1
Nitidulidae	" "	May 5	14	0	0.0
Ambrosia beetle	Oak wilt tree	May 10	11	0	0.0
Nitidulidae *	New cut stumps of healthy trees	May 14	87	0	0.0
Nitidulidae	Mats with perithecia	May 14	23	1	4.3
Staphylinidae *	New cut stumps of healthy trees	May 14	4	0	0.0
Mixed Groups *	" "	June 4	21	0	0.0
Mixed Groups *	" "	June 11	67	0	0.0
Staphylinidae *	Stump trap	Sept. 30	3	0	0.0
Staphylinidae	Old mat	Sept. 30	4	0	0.0
Nitidulidae	" "	Sept. 30	5	0	0.0
Molambo omato *	Stump trap	Sept. 30	4	0	0.0
Mixed Groups	Old mats	Oct. 10	15	0	0.0

* Free flying insects.

Table 2. Longevity of Endoconidiophora fagacearum on the bodies of insects.

Species	Source	Date cultured	Number Cultured	Number Positive	Percent positive
Lot #1, April 6 Collection Date					
Epuraea spp.	Fresh mats	April 8	130	37	28.5
		July 7	25	2	8.0
		Aug. 11	20	0	0.0
Lot #2, April 27 Collection Date					
Colopterus niger	Mature mats producing perithecia	April 29	98	6	6.1
		May 18	14	2	14.3
		July 7	25	1	4.0
		Aug. 11	18	5	27.8

Attempts to isolate E. fagacearum from seven lots of free-flying insects gave positive results from only one lot. From 120 Nitidulids, collected April 6 from traps baited with sawdust and yeast, two insects yielded the oak-wilt fungus.

Table 2 shows data indicating that the fungus can live for a considerable period in or on insects, if kept at a favorable temperature. Two lots of insects, both of the family Nitidulidae, were collected April 6 and April 27 respectively, and stored in a refrigerator at 9° C. Cultures of parts of each of the two lots made 2 days after collection indicated that 28.5 percent of Epuraea spp. were infested, and 6.1 percent of Colopterus niger. The remaining insects in each of the same two lots were cultured at later dates with positive results. Endoconidiophora fagacearum was cultured from Epuraea spp. 93 days after collection of the insects. The fungus was isolated from Colopterus niger after 107 days in storage at 9° C.

Discussion

Insects obtained during the winter, when few if any mats were being produced and insect activity was at a low level, resulted in few positive isolations. Likewise, cultures from insects collected during the summer, when very few mats were being formed, were negative. On the other hand, during those periods in the spring and fall when the insects were active and mats were being formed, a considerable proportion of the insects were carrying spore loads.

Insects collected from mats on which conidia and ascospores are being produced would be expected to have spores on their bodies because they tunnel through the mat and feed on the fungus. However, the body surfaces of certain insects such as the Nitidulidae are smooth and shiny, and the number of spores that adhere to their bodies when they leave the mat may be small. This fact is important in relation to the number of insects found on the mats and in the wounds and the number of infected trees produced. The chances of infection are probably augmented with increase in the number of insects visiting any one wound: the more inoculum the greater possibility that infection will result. This is particularly important in spring and fall when fungus mats are in prime condition.

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OAK WILT SURVEY, BUREAU OF PLANT INDUSTRY, PENNSYLVANIA DEPARTMENT OF AGRICULTURE, HARRISBURG, PENNSYLVANIA

TRANSMISSION OF ENDOCONIDIOPHORA FAGACEARUM BY SPORE-INFESTED NITIDULIDS CAGED ON WOUNDED HEALTHY OAKS IN PENNSYLVANIA

H. E. Thompson[1], B. L. Hadley, Jr.[2], and A. R. Jeffery[1]

In the early speculations on the manner of spread of the oak-wilt fungus (Endoconidiophora fagacearum Bretz) from diseased to healthy oaks, other than by root grafts, the role of insects seemed relatively simple.

Much information had been gained from past investigations of the insect vectors of the Dutch elm disease and the blue stain fungi. In addition, observations on wounded trees reported by Craighead et al. (1) supplied circumstantial evidence that insects are capable of spreading oak wilt. To corroborate these findings, it would seem necessary only to place spore-infested insects in wounds on healthy oaks and produce infections thereby. In a few cases, Norris (5) and Dorsey et al. (3) have been able to do this. Many others have found it difficult to accomplish.

In Pennsylvania, beginning in 1952, Craighead, Morris, and Nelson (2) tried unsuccessfully to produce infection in healthy oaks by caging spore-infested insects in the vicinity of fresh wounds. In 1953 similar results were obtained from experiments on a larger scale. Investigation was continued in 1954 by the present authors.

In the first series of plots nitidulids were collected from stump traps, from mats, and from under loose bark on freshly-cut infected oaks, using a bottle-type aspirator. Twenty-five insects each were placed in salve tins for a period of 16 to 20 hours, on pieces of mats producing ascospores. Three types of wounds were made: axe cuts, bark bruises, and auger holes. The axe cuts were made by driving an axe through the bark and slightly into the sapwood. The bark around the wound was lightly pried loose to give the insects a hiding place. The bark bruises were made by pounding the bark with a sledge hammer until the bark was cracked and loosened. Auger holes were drilled through bark and sapwood into the heartwood. A cage made of plastic screen was placed over each wound. An open salve tin containing portions of mat with insects was placed in the cage, which was then closed tightly with roofing cement and roofing nails. Table 1 shows the dates when the insects were caged from April through August 5.

By October 10, only two trees on which insects had been caged were found to be infected with oak wilt (Table 1). The dates of caging on these infected trees were April 19 and June 5. In contrast, nearly 50 percent of the trees artificially inoculated with the fungus during this period became infected.

In the second series, the insects were collected as before and placed on perithecia-producing mats for 1 to 2 hours. T-slits were made in the bark of the stem, branch, or terminal of 1-inch to 1 1/2 inch red and black oak saplings. The nitidulids were placed under the bark on the face of the sapwood and the T-slit was closed with gummed cellophane tape tightly enough to crush the insects. Usually two or three insects were enclosed in each slit. At intervals of from 2 to 3 weeks after the insects were placed on the trees, samples were collected from each tree near the point of inoculation and cultured for the presence of Endoconidiophora fagacearum. On June 15, to test the favorableness of this type of wound as an infection court, similar T-slits were made on seven additional trees and ascospores were placed on the surface of the sapwood.

With the exception of the one sapling that developed oak wilt symptoms, the fungus could not be isolated from any of the inoculated trees. The one sapling that did develop symptoms was caged on April 6, and first showed symptoms on June 15. Two of the ascospore-inoculated saplings developed oak wilt symptoms and the causal fungus was isolated from culture samples.

In the third series nitidulids were collected from mats producing perithecia, and placed individually in glass vials which were then transported a considerable distance from any known oak-wilt infections and fastened over the cut ends of branches of healthy red oak trees. Between April 15 and June 30, 72 insects were caged on individual trees, which were observed regularly for oak-wilt symptoms.

At the end of the 1954 season, only one tree has developed oak wilt, confirmed by a positive culture. April 30 was the date of caging on this tree.

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[1]Pennsylvania Department of Agriculture, Bureau of Plant Industry.

[2]Pennsylvania Department of Forests and Waters, Division of Research.

Table 1. Insect transmission of Endoconidiophora fagacearum. Results of tests with spore-infested nitidulids caged on wounded healthy oaks; Pennsylvania, 1954.

No. trees	Date caged	Number insects caged per tree	Results of inoculation: Oak wilt symptoms: No. trees	Oak wilt symptoms: Date	Fungus isolated: No. trees
5	April 19	25	1	June 11	1
8	April 28	25	0		0
5	May 12	25	0		0
5	May 18	25	0		0
8	May 26	25	0		0
7	June 5	25	1	July 6	1
6	June 15	25	0		0
6	July 2	25	0		0
3	August 5	25	0		0

Table 2. Insect transmission of the oak wilt fungus. Results of tests with insects placed in T-slits closed with cellophane tape; Pennsylvania, 1954.

No. trees	Date inoculated	Number insects used per tree	Results of inoculation: No. trees sampled	Date sampled	Culture result	Oak wilt symptoms: No. trees	Oak wilt symptoms: Date
9	April 6	2	7	April 21	+	1	June 15
10	April 13	2 - 4	6	May 6	-	0	
10	April 21	1 - 2	8	May 19	-	0	
10	April 28	2 - 4	5	June 1	-	0	
10	May 11	2 - 5	10	June 15	-	0	
10	May 19	1 - 5	10	June 29	-	0	
10	May 25	1 - 5	0				
7	June 15	Ascospores	0			2	June 27

Table 3. Insect transmission of the oak wilt fungus. Results of tests with nitidulids caged in vials fastened over the ends of cut branches; Pennsylvania, 1954.

No. trees	Date caged	Number insects caged per tree	Results of inoculation: Oak wilt symptoms: No. trees	Oak wilt symptoms: Date	Culture result
22	April 30	1	1	July 9	+
21	May 7	1	--		--
10	May 10	1	--		--
6	May 14	1	--		--
6	May 24	1	--		--
7	May 27	1	--		--

Although some positive infections were obtained by caging nitidulids exposed to mats producing ascospores on fresh wounds the total of 4 infections resulting in the 194 trees exposed indicates that the transmission of oak wilt by insects is not so simple as first supposed. It is widely accepted that the method of transmission is not efficient; if it were, spread of the disease each year would be much greater. In these experiments with insects under the most favorable conditions known for inoculation very few infections resulted, whereas during the same period about 50 percent of the trees inoculated with masses of ascospores became infected.

Many factors may be responsible for the low percentage of infections obtained. Himelick et al. (4) observed that infection would not take place from caged insects until the spring temperature became high enough to favor spore germination. However, in our experiments infection was obtained from caging during late April and again in early June, but caging during May did not produce infection. Zuckerman (6) found that wounds on healthy oaks remain susceptible to infection for the relatively short period of only 48 hours.

If there is no nearby source of inoculum or if cool temperatures immobilize the insects during this period the chances of successful inoculation apparently are small.

In attempts to isolate Endoconidiophora fagacearum from insects much difficulty is encountered in getting the fungus to grow in the presence of the many other organisms that develop on the culture media. It is possible that these same organisms, if they develop in the wound, may inhibit infection by E. fagacearum. However, very few of the individual insects from which the fungus was successfully isolated were collected from places other than mats. This would indicate that only a small proportion of the free-flying nitidulid population have been carrying spores.

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PENNSYLVANIA DEPARTMENT OF AGRICULTURE, BUREAU OF PLANT INDUSTRY

USE OF RADIOACTIVE TRACER FOR INVESTIGATION OF THE ACTIVITY PATTERN OF SUSPECTED INSECT VECTORS OF THE OAK-WILT FUNGUS

C. L. Morris, H. E. Thompson, B. L. Hadley, Jr., and J. M. Davis[1]

Circumstantial evidence accumulating in the past few years indicates that a number of species of sap and fungus-feeding flies and beetles are responsible for spreading the oak wilt disease from mycelial mats of the oak-wilt fungus (Endoconidiophora fagacearum) to wounds on healthy trees.

To trace the pattern of activity of the sap-feeding beetles, mainly Nitidulidae, a series of four plots was established. A total of 7,300 insects were then tagged with Iodine 131 and released in the centers of the plots. Table 1 lists the main groups and species utilized in the test. Red and black oaks in concentric circles were wounded in each plot prior to and following release of tagged insects. In addition, mycelial mats of the fungus collected from diseased trees were distributed periodically in several of the plots. The wounded trees and mats were checked daily and sometimes twice daily for the presence of tagged insects by means of portable scintillation counters. Figure 1 is a diagrammatic sketch showing plot locations and the location of wounded trees and mats in each plot. Plot centers were about 2000 feet apart.

Table 1.

NITIDULIDAE	STAPHYLINIDAE
Glischrochilus fasciatus (Oliv.)	Tachinus fimbriatus (Grav.)
Glischrochilus sanguinolentus (Oliv.)	
Glischrochilus quadrisignatus (Say)	
Carpophilus sayi (Parsons)	
Colopterus niger (Say)	
Colopterus semitectus (Say)	
Colopterus truncatus (Randall)	

Insects to be treated were collected from mats and from traps baited with corn meal and yeast or potatoes and yeast. These insects were treated 200 at a time in an apparatus designed and operated by of of the authors (J.M.D.). Treatment consisted of momentary immersion of the insects in a solution of radioactive Iodine (I-131). They were then transferred to petri dishes to dry for several minutes before release. Iodine 131 proved to be an excellent material for short term studies of insect distribution. Individual insects could readily be detected with the scintillation counter up to 3 weeks after treatment. Insects treated and released earliest appeared to retain the same amount of radioactivity as those treated and released 9 days later, indicating little loss due to rain or to contact with the ground during this period. Several insects imprisoned in fresh wounds and on fresh mats failed to leave a readable trace of the Iodine 131 in either situation when removed a week later. It is estimated that mortality of the insects due to the treatment was less than 5 percent.

The first insects were treated and released in plots 1 and 2 on May 4, 1954. Because of the cool weather prevailing at that time and the resulting inactivity of all insects, treatment and release of insects on the remaining two plots was delayed until May 13. During this period the insects that had been released earlier on plots 1 and 2 remained inactive, as did the native population of nitidulids on all of the plots. On May 14 the temperature reached 67° F. for several hours in the afternoon. Daytime temperatures from May 15 to May 30 were about normal, rising to 67° for at least 2 hours each day.

On May 15 the first tagged insects were located in a wound on a tree within 50 feet of the central release point in plot 2 and on a single mat located 200 feet from the center of plot 2. By May 16, approximately 48 hours after insect activity was resumed, tagged insects were found

[1] Respectively Pathologist, Pennsylvania Department of Forests and Waters; Entomologist, Bureau of Plant Industry, Pennsylvania Department of Agriculture; Entomologist, Pennsylvania Department of Forests and Waters; and Entomologist, Division of Forest Insect Research, U. S. Forest Service, Beltsville, Maryland.

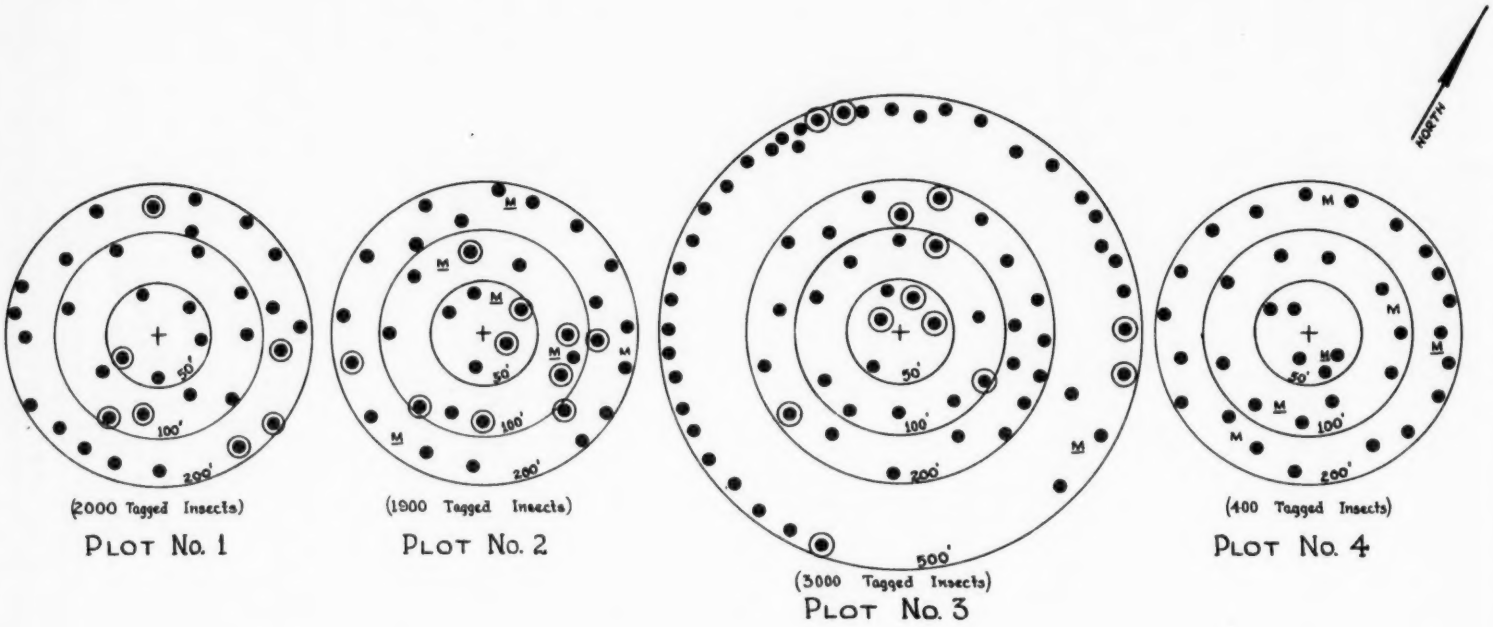

FIGURE 1. Distribution pattern of suspected insect vectors of the oak wilt fungus.

in wounds on four trees in three plots. By May 17 they had reached a peak of distribution and were picked up on wounds on 20 trees on plots 1, 2, and 3. None of the wounds on trees in plot 4, where insects were released directly on the mats in the center of the plot, attracted insects for the duration of the experiment. In comparison, three of the six mats distributed in this plot at various distances from the plot center had attracted large populations of tagged insects by May 17. The remaining three mats were less attractive because of apparent deterioration.

In general, there was very little movement of insects from mats or wounds after their initial entrance until the wounds or mats became desiccated. Examination of wounds on May 28 showed that the wounds harboring the largest number of tagged insects were those which had remained moist with fermenting sap and were characterized by fungus and bacterial contaminants. Wounds or mats that originally had attracted but were later deserted by tagged nitidulids had become quite dry.

The following observations were made during the experiment:

1 -- Temperature and Insect Activity: As would be expected, there was very little activity among the nitidulids until the air temperature reached 70° F. and remained there for several hours. The long period of wet, cool weather from April 26 to May 15, which was state-wide, effectively inhibited activity of the suspected insect vectors used in this experiment. Since most natural infection by the oak-wilt fungus appears to take place during early spring, these subnormal temperatures may explain, in part, why less than 10 percent of the total oak-wilt infection spots discovered during 1954 in Pennsylvania were recent (1954) infections. In 1952, current-year infections comprised 30 percent of the total.

2 -- Attractiveness of Mycelial Mats: Mycelial mats of the oak-wilt fungus proved to be powerful insect attractants. Tagged insects were known to be present for various periods of time on 9 of 13 mats placed within the plot areas and, in addition, on each of three mats located at various distances outside the plot boundaries. A fresh mat placed in plot 3 when temperatures were favorable for insect activity had already attracted tagged insects when it was checked 2 hours later. Observations of tagged insects released directly on mats in the center of plot 4 and of tagged insects attracted to mats distributed throughout the other plots indicate that these insects were attracted to and remained on mycelial mats until the mats deteriorated or were consumed by various larvae.

If it is assumed that nitidulids are the chief vectors of the disease, the attractiveness of the mats together with the tendency of these insects to remain on the mats as long as they are fresh, may help explain why the spread of the disease in some parts of Pennsylvania is often erratic. Studies of age of wound vs. period of infectivity initiated in Pennsyvlania during the spring of 1954 indicated that basal wounds over 3 days old on oaks 5 to 12 inches d.b.h. are not suitable infection courts for spores of the oak-wilt fungus. Consequently, if mats in the right stage of decline are not available at the time wounds are made or shortly thereafter, infection through these wounds is improbable.

3 -- General Pattern of Distribution: Figure 1 shows the location of wounded trees and mycelial mats. The total number of wounds and mats from which tagged insects were recovered throughout the duration of the experiment is indicated.

In general, insects were found earliest and in largest numbers at the nearest wounded trees, their number and incidence decreasing in wounds located at greater distances.

Two tagged specimens of Carpophilus sayi were recorded on fresh mats placed across a valley 1 mile from the nearest point of release. The mats were distributed on May 23 and the insects were noted the following day. Nearby traps of corn meal and yeast failed to attract any of the tagged insects.

4 -- Attractiveness of Wounds in Relation to Age and Type: There was no apparent relationship in this experiment between age of wound and attractiveness. Earliest wounds on all trees in plots 1, 2, and 3 were made on May 3 and May 4 (with the exception of the 50-foot circle in plot 2 which was wounded on April 29); the second series was made on the opposite sides of the same trees on May 13 or May 14. Only a single series of wounds was made on trees in plot 4 on May 14. The attractiveness of wounds is apparently correlated with the amount of sap exuded from the wound, which in turn is associated with weather conditions favorable to a high degree of physiological activity at the time of wounding. On one tree, natural wounds made earlier by a wood-boring insect and copiously exuding fermenting sap at first attracted more tagged insects than basal wounds on the same tree or on other trees in the plot.

There was no apparent relationship between type of wound and attractiveness. Wounds made by a single axe cut on the lower bole on odd-numbered trees in all plots proved equally as attractive to tagged insects as wounds made by bruising and breaking the bark with a sledge on even-numbered trees.

DIVISION OF FOREST RESEARCH, PENNSYLVANIA DEPARTMENT OF FORESTS AND WATERS

FUNGICIDE TESTS IN 1954 FOR THE CONTROL OF SYCAMORE ANTHRACNOSE

I. R. Schenider and R. J. Campana

The control of anthracnose (Gnomonia veneta) of sycamore by the application of various compounds has been reported (2, 3, 4, 7, 8). Also tests have been carried out to compare the effectiveness of various spray schedules (4, 7).

In our 1954 trials, nine compounds were tested for their effect in the control of sycamore anthracnose in the Illinois Natural History Survey experimental tree plot at Champaign. Also, seven spray schedules were compared in their control of the disease in Peoria; in these schedules, one fungicide, Puratized Agricultural Spray (phenylmercuri-triethanol ammonium lactate) was used[1]. Natural infection was relied upon in both experiments. Conditions for infection were generally very favorable in Illinois (1), but a much lower incidence of disease occurred in the Survey tree plot than in Peoria.

In the Survey tree plot, each compound was tested on ten 15- to 20-foot sycamores. These compounds were applied with hydraulic equipment, at three different stages of tree growth: Spray 1 (April 13), delayed dormant stage; Spray 2 (April 26), broken bud stage; and Spray 3 (May 3), young leaf stage. Leaf infection data were taken on May 28. To estimate the percentage of leaves infected, 25 leaves per branch, 4 branches per tree were examined. The percentage of leaves infected (Table 1) is based on the average number of infected leaves for the ten trees in any treatment, except for the Fermate treatment, in which the average is based on seven trees.

Table 1. Compounds tested on sycamores for control of anthracnose in 1954.

Sprays used		Percent of leaves infected	Percent of disease reduction
Compounds	Amount per 100 gallons of water		
Vancide 51 plus Vancide sticker	2 qt.	5.3	86
Dithane Z-78	2 lb.	9.3	75
Monsanto 4367 plus Tergitol 7	3/4 lb.	10.7	72
Orthocide 406	2 lb.	12.2	68
Phygon	1 lb.	12.5	67
Tag 331	1/2 pt.	16.2	57
Fermate	2 lb.	16.6	56
Emmi	1/2 pt.	17.8	52
Calcium sulfamate plus B-1956	3/4 lb.	27.8	26
Untreated	--	37.5	--

In the percentage of infected leaves the treated trees were significantly different from the controls, at the 1 percent level, in all treatments except that of calcium sulfamate plus B-1956.

Vancide 51, Dithane Z-78, and Phygon appeared more effective than in previous tests (4), but Tag 331 appeared less effective. Monsanto 4367 caused conspicuous chlorosis, which occurred both between the veins and at the leaf margins.

In Peoria, seven spray schedules were compared to see if any one schedule would give control superior to all others. Each schedule included either a single spray application or a combination of applications. Applications of delayed dormant, broken bud, and young leaf sprays, made with a hydraulic sprayer, were within 1 to 3 days of the corresponding treatment dates in the Survey tree plot. Ten 40- to 80-foot sycamores were included in each spray schedule tested. Percentage disease was estimated on 5 branches per tree, 10 trees per treatment, and averaged for each treatment. The averages of two estimates, one made on May 18 and the other on May 26, were themselves averaged. The data are shown in Table 2.

Incidence of disease was reduced significantly at the 5 percent level by the broken bud spray. The broken bud spray in combination with either or both of the other two sprays, and the young

[1] The cooperation of Mr. Rhodell Owens, Director of Parks, Peoria, is gratefully acknowledged.

Table 2. Disease reduction of sycamore anthracnose obtained with different spray schedules in 1954. Application of Puratized Agricultural Spray, one pint per 100 gallons of water.

Schedule[a]	Percent of leaves blighted	Percent of disease reduction
Spray 1	80	0
Spray 2	60	25
Spray 3	50	37.5
Sprays 1 and 2	40	50
Sprays 1 and 3	50	37.5
Sprays 2 and 3	40	50
Sprays 1, 2, and 3	40	50
Untreated	80	--

[a] Spray 1, delayed dormant; Spray 2, broken bud; Spray 3, young leaf.

leaf spray alone and in the combinations used, significantly reduced disease incidence at the 1 percent level. The delayed dormant spray had no significant effect on sycamore anthracnose in these tests.

Dimond and Potts (3) found that the delayed dormant spray of Puratized Agricultural Spray or Fermate had no effect on sycamore anthracnose. In 1950 Schuldt (7) found that the combination of dormant and broken-bud sprays and the combination of dormant, broken-bud, and young leaf sprays were significantly better, at the 1 percent level, than all other treatments. In 1952 Hoffman (4) found that spraying at the broken bud stage appeared to be of greatest significance. In our work, spraying at the young leaf stage seemed at least as effective as spraying at the broken bud stage. However, the delayed dormant application had no significant effect. Variations in environmental conditions may explain differences obtained by different workers using comparable spray schedules. Low temperature and high humidity appear important for disease development and severity (5, 6). Since temperature and humidity may vary each year in relation to leaf development, the control obtained with sprays timed to leaf development may also vary each year.

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SECTION OF APPLIED BOTANY AND PLANT PATHOLOGY, ILLINOIS NATURAL HISTORY SURVEY, URBANA, ILLINOIS

RED STAIN OF BOXELDER

E. Richard Toole[1]

Red stain in the sapwood of boxelder (Acer negundo L.) is so common that the wood is often characterized by it. In checking the possible cause of this stain in stands in the Mississippi Delta, the author consistently isolated a species of Fusarium. This fungus was identified as F. negundinis Sherb. and is apparently identical with that described by Hubert[2].

Hubert produced the stain by inoculating small boxelder blocks in the laboratory. The purpose of the present study was to determine if the fungus will cause the stain in living trees.

Methods: Two tests were installed in two locations and at two times of year. The first test was established on March 30, 1953, in the Delta Experimental Forest, Stoneville, Mississippi. Fifteen boxelder trees 8 to 10 inches in diameter at breast height were inoculated with F. negundinis. With an increment borer, four holes were made in each trunk at about breast height. These holes were 2 inches deep. The bark surface and the borer were sterilized with alcohol before each hole was made. Inoculation was accomplished by inserting into each hole a block of agar on which a mass isolate of F. negundinis was growing. On an additional five trees, sterile agar was substituted for the fungus.

The second test was installed on September 30, 1953, on lands of the Chicago Mill and Lumber Co. at Huntington Point, Mississippi. In this test, 20 trees were inoculated and 10 used as checks. The procedure was the same as in the first test except that the holes were plugged with corks in an effort to eliminate natural infection.

Results: Notes on the results of the first experiment were taken after 3 months. The second test was allowed to run 9 months before examination.

Table 1. Results of inoculation of boxelder trees with Fusarium negundinis; Delta Experimental Forest, Mississippi.

Test and treatment	Number of bore holes			
	Total	With no stain	With trace of stain	With abundant stain
First test				
Check	20	7	13	0
Inoculated	60	3	8	49
Second test				
Check	40	32	8[a]	0
Inoculated	80	0	2	78

[a] This stain apparently originated through dead tissue above and below the holes, and not through the holes themselves.

In both tests it was at once evident that red stain was associated with many more of the inoculated holes than of the check holes (Table 1). Analysis of the data for the first test gave a Chi square of 42.39 on two degrees of freedom, indicating a highly significant difference between the inoculated and check holes. In the second test the Chi square was 112.88 on two degrees of freedom, also a highly significant difference.

Where red stain was abundant it had spread 6 to 8 inches above and below the holes. Where traces were recorded a few narrow streaks an inch or so long were observed.

[1] Stationed at Delta Research Center, Southern Forest Experiment Station, Forest Service, U. S. Department of Agriculture. The Delta Research Center is maintained in cooperation with the Mississippi Agricultural Experiment Station at Stoneville, Miss., and is partially financed by the Southern Hardwood Forest Research Group.

[2] Hubert, E. E. 1923. The red stain in the wood of boxelder. Jour. Agr. Res. 26: 447-457.

Fusarium negundinis was reisolated from inoculated holes and also from contaminated check holes.

Discussion: Both tests indicate that F. negundinis can cause red stain in living boxelder trees. The difference between the two tests is probably due to natural infection occurring in the unplugged check holes of the first test, rather than to differences in time of inoculation or location. The few traces of stain in the checks in the second test originated at wounds made by the dying of the cambium for several inches above and below these holes rather than at the holes.

DELTA RESEARCH CENTER, SOUTHERN FOREST EXPERIMENT STATION, FOREST SERVICE, U. S. DEPARTMENT OF AGRICULTURE

NUT DISEASES IN OREGON IN 1954

P. W. Miller

WALNUT DISEASES

Walnut Blight (Xanthomonas juglandis (Pierce) Dowson) was widely distributed and caused greater economic loss than in 1953.

Mushroom Root Rot (Armillaria mellea Fr.) caused the decline and the death of Persian walnut trees (Juglans regia) grafted on both Hind's black walnut (Juglans hindsii) and Persian walnut rootstocks. In general, incidence was greater in upland orchards and in orchards on poorer soil types than in orchards in river bottoms on better soil types.

Leaf Scorch (non-parasitic) was widely distributed in western Oregon where it occurred to a greater or less extent in most Persian walnut orchards.

Black-line (Girdle) of Grafted Walnuts (non-parasitic) was responsible for the death of more Franquette walnut trees grafted on black walnut roots in Oregon than all other causes combined. The importance of black-line in the decline of grafted walnuts in this State was indicated by the current results of a tree-by-tree survey made in 32 widely scattered grafted walnut orchards containing more than 11,000 trees. In these 32 orchards 1,065 new cases of declining trees, 79 percent of which were declining from black-line were found. In most of these orchards two to three times as many new cases of black-line were observed in 1954 as in 1953. The disorder occurred to a greater or less extent in practically all walnut-growing districts in the State. In general, incidence was greater in upland than in river bottom orchards. All trees found affected were of the Franquette variety grafted on Hinds black walnut rootstocks or its hybrids. One case of black-line was found on what appears to be a Paradox hybrid, which is a cross between Persian and Hinds black walnut. Not a single case was found in Persian walnuts grafted on pure Persian walnut rootstocks.

Crown Rot (cause undetermined). A crown or collar rot of undetermined cause was found affecting a limited number of Persian walnuts grafted on Hinds black walnut rootstocks and some Persian seedling walnuts. Attempts to isolate a Phytopathora sp. or some other parasitic organism were uniformly negative.

Downy Spot (Microstroma juglandis (Bereng.) Sacc.) occurred in limited amounts in a few walnut orchards in the Willamette Valley. It was of no economic importance since it did not cause defoliation or decrease the functional leaf area markedly.

FILBERT DISEASES

Bacterial Blight (Xanthomonas corylina (Miller et al) Dowson) was widely distributed in western Oregon and occurred to a greater or less extent in practically all filbert orchards in the State. It was most prevalent in the northern part of the Willamette Valley in older orchards, where it caused the death of many small twigs and branches.

Powdery Mildew (Phyllactinia corylea Karst.) was present to a greater or less extent in numerous filbert orchards in western Oregon, but was of no economic importance as it did not appear until near the end of the season and the leaves persisted on the trees until the time of normal leaf fall.

Brown Stain (non-parasitic). This disorder, which is characterized by exudation of a brownish liquid from the shell and abortion of the embryo, was present in limited amounts in a number of orchards in Oregon. Crop losses were insignificant, however.

AGRICULTURAL RESEARCH SERVICE, HORTICULTURAL CROPS BRANCH, UNITED STATES DEPARTMENT OF AGRICULTURE, OREGON STATE COLLEGE, CORVALLIS, OREGON

UNUSUAL RECORDS OF PLANT DISEASES

A NEW NEMATODE ON RICE IN TEXAS AND LOUISIANA

By John G. Atkins, Max J. Fielding, and John P. Hollis[1]

Radopholus oryzae (van Breda de Haan) Thorne recently has been found in examining soil-rice root samples from one location near Beaumont, Texas and seven locations in southwestern Louisiana. So far as the writers are aware the nematode found has not been recorded previously from the United States. R. oryzae has been reported to damage rice roots in certain Asiatic areas. Studies are planned to determine the distribution of the nematode in Texas, Louisiana, and the other southern rice-growing States, and its importance on rice.

FIELD CROPS RESEARCH BRANCH AND HORTICULTURAL CROPS RESEARCH BRANCH, AGRICULTURAL RESEARCH SERVICE, U. S. DEPARTMENT OF AGRICULTURE, THE TEXAS AGRICULTURAL EXPERIMENT STATION, AND THE LOUISIANA STATE UNIVERSITY, COOPERATING

[1] Agent (Plant Pathologist), Field Crops Research Branch, Agricultural Research Service, U. S. Department of Agriculture, Beaumont, Texas; Assistant Nematologist, Horticultural Crops Research Branch, Agricultural Research Service, U. S. Department of Agriculture, Baton Rouge, Louisiana; and Assistant Plant Pathologist, Plant Pathology Department, Louisiana State University, Baton Rouge, Louisiana, respectively.

A CORRECTION

The organism referred to in paragraph 2, line 3, on page 879 of the article by Mihailo Krstić in the December issue should obviously be Trichoderma viride.

PROGRAM

Southern Division - American Phytopathological Society

February 7, 1955

Monday Morning -- 8:15 a.m.

Louis XIV Room, Brown Hotel

Presiding - J. N. Sasser, N. C. State College, Raleigh, N. C.

1. Crittenden, H. W. — Root Knot Nematode Resistance of Soybeans (15 minutes, lantern). University of Delaware, Newark, Delaware.

2. Graham, T. W. — Pathogenicity of Rotylenchus brachyurus on tobacco and Criconemoides sp. on tobacco and peanuts (12 minutes, lantern). Pee Dee Exp. Sta., Florence, S. C.

3. Holdeman, Quintin L. — The effect of the Tobacco Stunt Nematode on the Expression of Fusarium Wilt in Flue Cured Tobacco (10 minutes, lantern). Pee Dee Exp. Sta., Florence, S. C.

4. Martin, W. J., L. D. Newsom and Jack E. Jones. Relationship of Nematodes of the Genera Meloidogyne, Tylenchorhynchus, Helicotylenchus and Trichodorus to the Development of Fusarium Wilt in Cotton (12 minutes, lantern). Louisiana Agr. Exp. Sta., Baton Rouge, La.

5. Krusberg, Lorin R., and J. N. Sasser. The lance nematode, Hoplolaimus coronatus Cobb, A Parasite of Cotton (15 minutes, lantern). N. C. State College, Raleigh, N. C.

6. Nusbaum, C. J. Variable Effects of Nematocides on Parasitic Nematode Populations in Row Fumigated Tobacco Plots (15 minutes, lantern). North Carolina State College, Raleigh, N. C.

Business Meeting -- 10 a.m.

Presiding - President J. H. Miller
Department of Plant Pathology,
University of Georgia, Athens,
Georgia.

Election of Officers

President (1 year term)
Vice-President (1 year term)
Councilor (2 year term)

Monday Afternoon -- 1:30 p.m.

Louis XIV Room, Brown Hotel

Presiding - E. J. Cairns, Alabama
Polytechnic Institute,
Auburn, Alabama

1. Smith, H. E. Opportunity for Impoving Agriculture in the South Through Plant Disease Control (15 minutes). Univ. of Ark., Fayetteville, Ark.

2. KenKnight, Glenn and J. F. Jones. Role of Black Peach Aphid in Spread of Crown Gall. (7 minutes). U. S. Hort. Field Lab., Ft. Valley, Ga.

3. KenKnight, Glenn Thermotherapy and Chemotherapy of Peach Rosette. (15 minutes). U. S. Hort. Field Lab., Ft. Valley, Ga.

4. Hebert, T. T. and N. T. Coleman. Rod Shaped Particles Associated With Soil Borne Wheat Mosaic. (10 minutes, lantern). N. C. State College, Raleigh, N. C.

5. Nusbaum, C. J. and J. N. Sasser. Comparison of EDB (W-85) and D-D Applied as Liquids and Impregnated on Vermiculite for Nematode Control (15 minutes) lantern). N. C. State College, Raleigh, N. C.

6. Henderson, R. G. and A. S. Williams. Effect of Soil Insecticide Treatments on Alfalfa-Stem Nematode (15 minutes). Va. Agr. Exp. Sta., Blacksburg, Va.

7. Cairns, Eldon J. Pathogenicity of Plant-parsitic Nematodes in the Absence of Associated Microorganisms (15 minutes, lantern). A. P. I., Auburn, Ala.

8. Tarjan, A. C. and P. C. Cheo. Reduction of Root-parasitic Nematode Populations in Established Bent Grass Turf by use of Chemi-

cal Drenches (15 minutes, lantern). Univ. of R. I., Kingston, R. I.

9. Feldmesser, Julius and Wm. A. Feder. Organic Mercury Dips for the Control of Nematodes in Roots of Living Plants (12 minutes, lantern). Agr. Res. Ser., Sanford, Fla.

10. Machmer, J. H. and L. W. Boyle. Ring Nematodes, Criconemoides, Thrive With Peanuts After Certain Nematocides (15 minutes, lantern). Agr. Res. Ser., Tifton, Ga.

11. Machmer, J. H. Methods in Conducting Surveys of Soil Separable Nematodes of Given Crops by Locality or Region (15 minutes, lantern). Agr. Res. Ser., Tifton, Ga.

February 8, 1955

Tuesday Morning -- 8:30 a.m.

COTTON DISEASE COUNCIL (meeting room to be announced)

Presiding - A. L. Smith, A. P. I., Auburn, Ala.

Joint Session With the Crops Section of the

American Society of Agronomy

(Meeting room to be announced)

SYMPOSIUM

Forage Crop Diseases and Grassland Farming

Presiding - J. Lewis Allison, N. C. State College, Raleigh, N. C.

1. Butler, Karl D. Grassland Farming. Ithaca, N. Y.

2. Hensen, Lawrence Colletotrichum Species Attacking Grassland Crops. Ky. Agr. Exp. Sta., Lexington, Ky.

3. Johnson, Howard W. Soil Borne Fungus Pathogens of Grassland Crops. Agr. Res. Serv., and Miss. Agr. Exp. Sta., Stoneville, Miss.

4. Kreitlow, Kermit W. Virus Diseases of Grassland Crops. Agr. Res. Ser., Beltsville, Md.

5. Allison, J. Lewis Nematodes and Grassland Crops. Agr. Res. Ser. and N. C. Agr. Exp. Sta., Raleigh, N. C.

6. Burton, Glen W. Breeding for Disease Resistance in Grassland Crops. Agr. Res. Ser. and Ga. Agr. Exp. Sta., Tifton, Ga.

Tuesday Afternoon -- 1:30 p.m.

Louis XIV Room, Brown Hotel

Presiding - E. C. Tims, La. State Univ., ., Baton Rouge, La.

1. Heggestad, H. E. — Burley, Flue Cured and Cigar Wrapper Varieties Compared in Resistance to Black Shank and Fusarium Wilt (10 minutes, lantern). U. S. Dept. of Agr., Greenville, Tenn.

2. Frederick, T. Wolf — Nutrition and Metabolism of the Tobacco Wilt Fusarium (12 minutes, lantern). U. S. Dept. of Agr., Nashville, Tenn.

3. Heggestad, H. E. and E. E. Clayton. Development of Burley Varieties Resistant to Black Shank, Fusarium Wilt, Wildfire, Tobacco Mosaic and Black Root Rot (15 minutes, lantern). U. S. Dept. of Agr., Greenville, Tenn.

4. Henderson, R. G. — Evaluation of Burley Tobacco Varieties (15 minutes, lantern). Va. Agr. Exp. Sta., Blacksburg, Va.

5. Moore, E. L., P. N. Drolsom and E. E. Clayton. High Black Shank Resistance and Tolerance to Parasitic Nematodes in Flue-Cured Tobacco (15 minutes, lantern). N. C. Agr. Exp. Sta., Raleigh, N. C.

6. Apple, J. L. — Morphological and Physiological Comparison of Certain Isolates of Phytopthora parasitica var. nicotianae (15 minutes, lantern). N. C. State College, Raleigh, N. C.

7. Kelman, Arthur and L. H. Person. Variation in Pathogenicity of Isolates of Psuedomonas solanacearum on different hosts (15 minutes, lantern). N. C. State College, Raleigh, N. C.

8. Apple, J. L. — Pathogenic Variation Among Single Zoospore Isolates of Phytophthora parasitica var. nicotianae (10 minutes, lantern). N. C. State College, Raleigh, N. C.

9. Harrison, A. L. — Damping-off of Tomato Transplants (12 minutes, lantern). Texas Agr. Exp. Sta., Yoakum, Texas.

10. Armstrong, J. K., and G. M. Armstrong. Host Relationships of the Wilt Fusaria From Spinach and Beet (10 minutes, lantern). Clemson Agr. College, Clemson, S. C.

11. Armstrong, J. K., and G. M. Armstrong. The Sumac Wilt Fungus a Race of the Aster Wilt Fusarium (10 minutes, latern). Clemson Agr. College, Clemson, S. C.

February 9, 1955

Wednesday Morning -- 8:30 a.m.

Louis XIV Room, Brown Hotel

Presiding - W. W. Hare, Miss. Agr. Exp. Sta.
State College, Miss.

1. Hare, W. W. — Resistance to Cercospora in Pepper (15 minutes, lantern). Miss. Agr. Exp. Sta., State College, Miss.

2. Reed, H. E. — Studies on Barley Scald and Its Control in Tennessee (15 minutes, lantern). Tenn. Agr. Exp. Sta., Knoxville, Tenn.

3. Hare, W. W. — Resistance to Fusarium Wilt in Brown Sugar Crowder Cowpeas (15 minutes, lantern). Miss. Agr. Exp. Sta., State College, Miss.

4. Taylor, Jack — Apple Black Rot in Georgia (15 minutes, lantern). Ga. Mt. Exp. Sta., Blairsville, Ga.

5. Tims, E. C. — Some Hosts of the Pink Root Fungus (Pyrenochaeta terrestris) in Louisiana (15 minutes). La. State Univ., Baton Rouge, La.

6. Tims, E. C. — Onion Pink Root on Some Other Plants in Louisiana (15 minutes). La. State Univ., Baton Rouge, La.

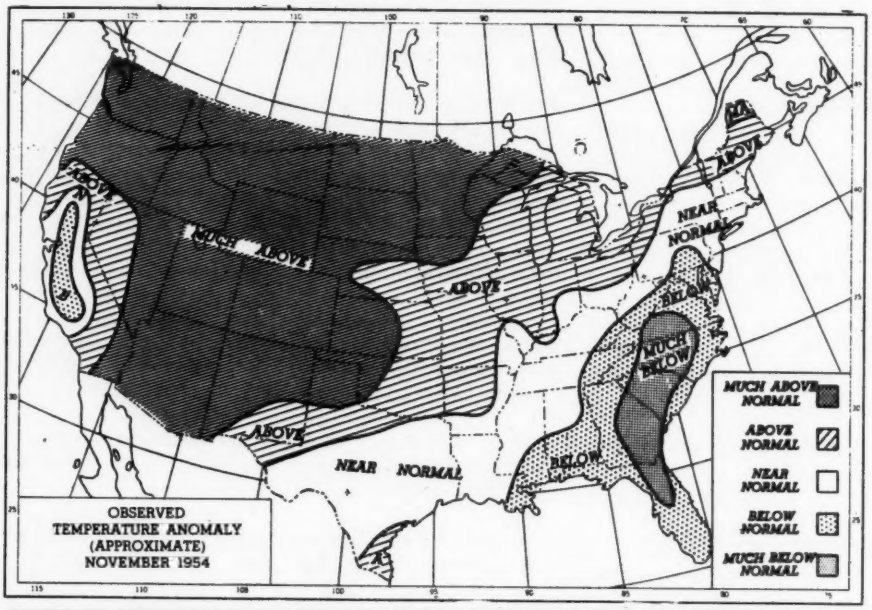
7. Horn, N. L., and W. F. Wilson. Evidence for Seed Transmission of Cucumber Anthracnose (10 minutes). La. State Univ., Baton Rouge, La.

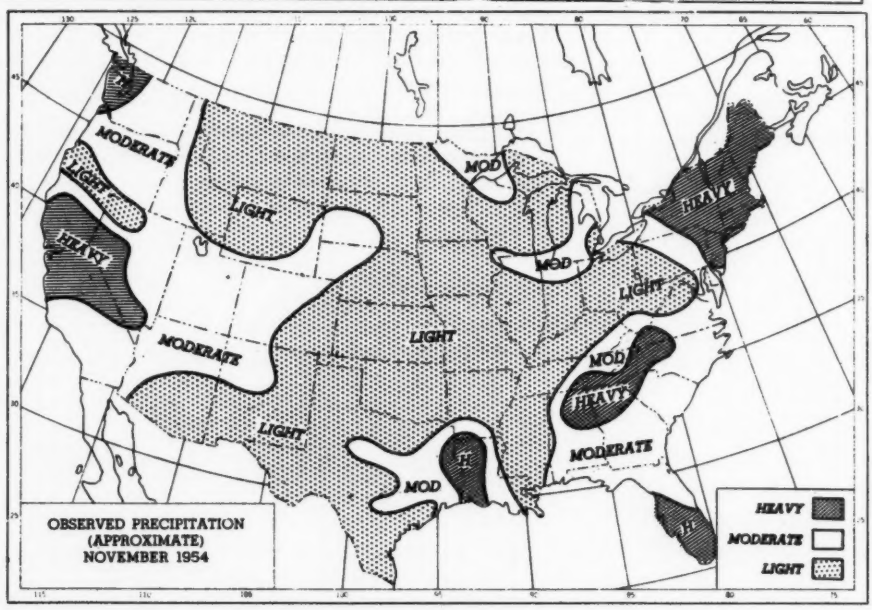
8. Young, B. W. and G. A. Brandes. Effect of Fungicides on the Survival of Cotton Seedlings (15 minutes, lantern). Rohm & Haas Co., Philadelphia 5, Pa.

9. Foster, H. H. — Peach Brown Rot and Scab Control in South Carolina (15 minutes). S. C. Agr. Exp. Sta., Clemson, S. C.

10. Whitehead, Mardin D. — Some Observations on the Pathological Histology of Downy Mildew, Sclerophthora macrospora, of Corn (15 minutes, lantern). Texas Agr. Exp. Sta., College Station, Texas.

11. Kilpatrick, R. A. — Fungi Associated With Unopened and Opened Soybean Flowers at Stoneville, Miss. (15 minutes). Miss. Agr. Exp. Sta., Stoneville, Miss.





The terms used in the accompanying maps, which define the ranges of temperature and precipitation, are numerical class limits. These are based on a statistical analysis of past records through which is determined the normal frequency of occurrence of temperatures and precipitation at various times of the year for different locations. For temperature the classes above, below, and near normal are so defined that they each normally occur one-fourth of the time; much above and much below normal, one-eighth of the time. Precipitation is depicted in terms of light, moderate, and heavy, each class normally occurring one-third of the time and thereby having equal probability of occurrence. These maps graphically represent only the general trends and give the country's weather picture at a glance. For quantitative studies, where monthly mean temperatures and actual precipitation records are needed for a given time and place, other publications of the Weather Bureau should be consulted. P. R. M.

MANUSCRIPTS FOR THE PLANT DISEASE REPORTER

(See also PDR 35: 121-122; 36: 214, 494)

(1) GENERAL: The Reporter page measures 9 inches long with the heading or 8 3/4 inches for the text part, by 6 inches wide. The copy is typed on a larger page, 11 1/4 inches of text or 12 inches overall in length by 8 inches in width, and reduced 25 percent in the photographic process of reproduction. Illustrations or tables larger in either dimension will take a correspondingly greater reduction. Only one size of type is available for text, footnotes, or tables.

(2) MANUSCRIPTS should be the original ribbon copy, not carbons, clearly typed and double-spaced throughout, including tables, footnotes, and bibliographies. (Note -- only one copy is needed.) Footnotes should be typed at the bottom of the page.

(3) ABSTRACTS are requested for all except very short articles. (PDR 38: 316).

(4) CAUSES OF DISEASES should be named. For bacteria, fungi, nematodes, etc., give the Latin name of the organism; for viruses either or both the accepted common name of the virus or a Latin name if you prefer it and there is one; for non-parasitic diseases state the causal factor if it is known. If the cause of a disease has not been determined say so. (PDR 36: 494).

(5) LITERATURE REFERENCES should be given in alphabetical order and numbered for citation in the text. We follow the AIBS suggestion of placing the year of publication after the author's name. Please check your titles carefully since we cannot do it for you. Be sure that text citations and bibliography agree; that foreign-language references are correct; that number or month is cited for periodicals that are not paged consecutively throughout the volume.

(6) NAMES OF FUNGICIDES should be given according to the suggestions that will be published in Phytopathology before long, and later repeated in the Reporter. In the meantime see PDR 35: 122.

(7) ILLUSTRATIONS should be sent to us unmounted. To prevent mistakes, write figure numbers on the back, and mark the top of each print when necessary. A sketch can show a preferred arrangement but please keep in mind page size, shape, and standard reduction (see above under General), and remember that figure titles and legends are part of the page. Lettering should be clear and large enough to be legible after reducing. Drawings, maps, and graphs can be photographs or originals, but should be finished and ready for reproduction, not just sketches.

(8) TABLES should be carefully thought out with particular attention to the Reporter's limitations in reproduction. Make titles and headings definite and self-explanatory. Designate footnotes in tables with superscript lower-case letters. Be sure that text discussion agrees with the data in the table. Do not abbreviate names of crop varieties.

(9) REPRINTS cannot be supplied since there is no way in which we can be reimbursed. However,

(10) The MULTILITH PLATES from which reprints can be made will be sent if requested at the time the article is submitted. The press size of these plates used for the Reporter is designated as small -- maximum image 9 1/2 by 13 inches, maximum paper size 9 3/4 by 14 inches -- for Model 1250. Most of the Experiment Stations have this type of multilith machine.

(11) We are the official correspondents in the United States of the PLANT PROTECTION BULLETIN published monthly by the United Nations Food and Agriculture Organization. We would appreciate it if plant pathologists would send us suitable material from time to time for inclusion in our monthly summary reports. Please mark it clearly so that we will know it is intended for the Bulletin. (See PDR 36: 492; 37: 637) -- P. R. M.